

November 21, 1960

Aviation Week

and *Space Technology*

SPECIAL REPORT:

Design Details
Of Bell Hustler
Rocket Engine

A McGraw-Hill Publication

Avco Mk. 5 Re-entry Vehicle
On Minuteman





*HI-LOK

by VOI-SHAN

1 Grip advantage: 1/32 inch rim contourline absorbs initial shock-min vibration

2 Progressive tightening: Hi-Lok Control over-torque. The collar regulates at pre-set desired torque level

3 Weight savings: Hi-Lok is as much as 29% lighter than conventional AN bolt wet/water combination

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Consistently controlled profile, minimum run and wet/dry, plus speed of installation are outstanding advantages of the new Hi-Lok fastener now being produced by Voi-Shan. The Hi-Lok is the result of a design effort to provide an advanced fastener system incorporating as many desirable features as possible with the greatest simplicity. In one product, Hi-Lok is done from one look of the work. Simply saving its time/weight costs. Power tooling is an added time savings. Automatically, automatic torque control is incorporated by means of a slowly controlled shear groove in the Hi-Lok collar. Available in a wide range of sizes and material combinations. The Hi-Lok is produced with the accepted Voi-Shan precision workmanship and quality control for maximum performance. Write for further details and specifications.

6 Speed installation: Automatic and high speed power tool use is fast and quiet. Hard tool installation and removal is easy and permits re-use of the Hi-Lok pin

VOI-SHAN MANUFACTURING COMPANY

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Today Goodyear is fully capable of meeting all requirements for high-speed aircraft tires—the jettison flying now and tomorrow. Call your nearest Goodyear field office for complete details. Or write or telephone to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. WAT10, Akron 16, Ohio. Remember...all of good things come from Goodyear.



Wouldn't almost "twice" the advanced testing of strength tires in Goodyear's new ultrahigh dynamometer system. First to accurately duplicate all test operating conditions, system enables tires up to 220 mph, 1000 revolutions in one spin. Today's tire checking and design for 2000+ hours!



Toughest jet tire in Goodyear's famous fabric-reinforced-tread line. Diagram shows how extra-strong nylon fabric "locks" in built-up tire tread just below surface. Pattern helps maintain tread integrity during brutal stress of high speed landings and takeoffs.

GOOD YEAR

New Honeywell "blockhouse" means accurate and reliable

more computers!



Honeywell's basic computer building block modules.

The Honeywell building block modules as right can be assembled in various combinations to provide exactly the computer functions required. Building block construction from the shelf modules in terms of reliability, precise reliability, faster delivery and lower cost.



New computer "blockhouse" houses Honeywell's expanding aerial guidance computer projects. Located in St. Petersburg, Florida, the building adds to Honeywell's main St. Petersburg facility (shown in background). This is the only facility in the world built specifically for the design and development of aerial guidance systems.

Honeywell's new computer building provides the most perfect environment possible for the development of more accurate and reliable inertial grade computers.

Within this new blockhouse, Honeywell now has under test or in production two advanced types of General Purpose Computers and two Inertial Computers. Three of these new computers are specially designed around Honeywell's new standard welded module computer building blocks. This welded module construction permits a high degree of environmental resistance. Standard 1/2" deep module packing density, for example, is greater than 300,000 components per cubic foot. For the new Honeywell Micro Welded Module 1/2" deep, the packing density is 600,000 components per cubic foot.

These computer building blocks consist of two basic types of units—Aero-Space and Marine—as shown below.



AERO SPACE UNIT



MARINE UNIT

To each of these units is added one of three Honeywell environmentally-tested standby down units. These down units are:

- Up to 300 bits per inch
- 25 tracks per inch
- Multiple head assemblies for maximum adjustment
- T I R. Less than 30 microseconds of an inch
- Head electrical characteristics compatible with solid state memory



1/2 inch wide
300,000 bits



1/2 inch wide
300,000 bits



1/2 inch wide
300,000 bits

Honeywell has been developing a wide variety of Aero-Space and Marine Inertial Guide Computers since 1954. The company is fully qualified to develop and build environmental whole-units and/or environmental components of an advanced nature to meet your special requirements. To learn how Honeywell can solve your inertial guide computer problems, contact your nearest Honeywell representative. Or write: Honeywell Aeronautical Division, Dept. AW-01-178, 13350 U. S. Highway 19, St. Petersburg, Florida.

Honeywell



Military Products Group

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good mind
to do it at*



ALLISON

DIVISION OF GENERAL MOTORS, WARREN, MICHIGAN

Imagize a nuclear power plant that can be sealed in a vault and produce electricity for years . . .

A regenerative, silent, portable power source with no moving parts . . .

An electricity-producing liquid metal fuel cell one-tenth the size of other types of cells generating equal amounts of power . . .

Allison researchers have applied for patents covering their discovery of such a power plant—the Thermally Regenerative Fuel Cell.

It can be used in submarines, power stations, space platforms, magnetohydrodynamic propulsion devices and in many other areas.

And this is but one of the research and development projects we're putting our minds to at Allison. In the nuclear area alone, we are working on a nuclear rocket engine, direct conversion systems, and, with the Nuclear Development Corporation of America under an AEC contract, on the Mobile Compact Reactor. Our efforts are aided by our Scientific Advisory Committee, American and European consultants, plus every resource General Motors commands.

Whether your problem is concerned with the heavens, the earth, or the ocean, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others, we could do it for you.

Illustrated is a laboratory model of a thermally regenerative liquid metal fuel cell for the conversion of heat to electricity, jointly developed by Allison and Delco-Remy Divisions.



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IS OUR BUSINESS**



Key positions open for nuclear scientists and engineers. Write: Mr. R. A. Rhodes, Scientific Personnel Recruitment,

Recording the situation and environment



When airplanes land struts and gear wobble, Kodak got in start making automatic aerial recording device, the first of which may even have been marvelous.

This is a picture of one, a K-1 Aerial Camera. It could with one loading deliver 100 sequence exposures of the ground at an automatic fast or slow rate, depending upon the air speed of the plane it was flying in.

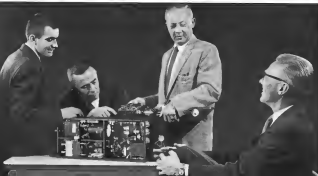
Motor power for the not-too-erratic but workable and automatic film advance and shutter-clicking mechanism being supplied by a gear train driven by a flexible shaft.

and air turbine arrangement. The turbine being attached outside of the plane in the wakestream (unperturbed drag being then not what it is today).

Another version—smaller camera—was nicknamed "Whistling Jim," because its propeller-driven flexible shaft whistled merrily while it worked in the plane's slipstream. "Jim" whistled well enough to justify government faith, and we were encouraged.

We are still encouraged, now that airplanes are called jets and rockets are called birds, to be asked to make some automatic photographic recording devices that can hardly be called mere cameras. Among these is a radar recorder we have just completed.

This is a picture of the complete package, along with some of the Kodak people who make up the force in being that created it.



-Kodak style

This is the kind of picture that Kodak built the radar recorder to deliver. Though it never takes a lens outside the confines of its atmosphere, however, it has.

Our invitation to invent a device like this probably came about not just because we have a reputation for wrapping up electronics, precision mechanics, optics, and photography into one package. We think we got the bug because some body wanted to end up with a good picture.

The logic economy in this radar recorder is what allows the CRT display to present one and only one TV frame in the recording camera while the camera shutter is open, exposing one and only one film frame. Early routine range for a good exposure, but it makes for nice, usable pictures.

Noted in amongst other Class II equipment (nowhere in the bowels of the German-designed A3F-1 "intruder" for the U S Navy, this radar recorder will go about its business of converting electrical signals into CRT displays, receiving and registering analog data and presenting digital data—placing all on stage at the same time to be photographed automatically as signal, at a rate of 1 picture per second or 2 pictures per second. All this takes place in a little more than a cubic foot of space and costs only 38 lbs. in weight.

Later on, when training officer or debriefing officer wants to know the who, what, where, when, why, and how of the fight, a lot of film will tell much, much that happens over had not been known they had seen.

In this case, the bit of film happens to be Kodak Plus-X Pan Film, 35mm.

That Plus-X is currently a popular film name was no criterion. Our Photorecording Methods Division



making recommendations only after consulting a big lot of Kodak film is being, the popular as well as the special day.

Here you see behind of Kodak IntraGraph ShearFilm film, which can pick out certain bright objects and other objects of similar brightness. Or a special Kodak plate made for 0.00002" per linear inch for recording the paths of light blinking flying objects against the stars on a clear night. Or Kodak IntraGraph Pan film, which is equally adept at seeing the point of reflection of a momentary trace on a CRT or the condition of what has whizzed by as a supersonic sled track. Or Kodak IntraGraph Dura film, an extremely high contrast film, recently doubled in speed, which reads green phosphor CRT displays with no stress.

And these make only a beginning to the very big families of new high-speed Kodak color films which reveal subtle and significant color directions, of aerial film for mapping and reconnaissance and the art of color slide rules we put out for com-

paring proper exposure of aerial film under all conditions. Or those Kodak films and papers with the unique capability of bringing an image to light immediately after exposure.

Information about these, only and all is obtainable from Kodak, Photorecording Methods Division, Eastman to 4, N. Y.

We pay good money to tell you about the radar recorder Kodak built and a few Kodak films not because we would like you to put on your hat and go out to buy one or the other. Rather, we would like to make an impression on anyone who thinks he has a problem in either instrument recording photography or any related device, as varied as still to be invented, which ultimately must deliver a photographic version of its own. We hope to force the idea with you that at Kodak there exists a place as broad as the knack of finding good answers to such problems, and knows what to expect from photographic film, paper, and plates.

PHOTOGRAPHY
OPTICS
ELECTRONICS
MECHANICS
APPROX

For a booklet that succinctly summarizes our work in co-ordinating these fields, write Command Construction Department.



Send me next mail talk of the connection between our capabilities and your problems?



Why the aircraft industry uses more Cutler-Hammer switches and power relays than any other brand

When human lives and huge investments of money are at stake, infallible operation of all component parts is essential. There is no place for a switch or power relay which doesn't perform with complete reliability.

It's no wonder, then, that more Cutler-Hammer switches and power relays are used in the aircraft and missile industry than any other. Cutler-Hammer has been the symbol of quality and reliability in the aircraft industry for more than 35 years.

We not only meet standards, we've set them!

Every switch and power relay is carefully checked at our factories. A continuous program of life and reliability testing of production units assures maintenance of quality at the highest level. We have a complete line from which to choose. If we don't have the one you need in our huge assortment, we'll be glad to develop it. To learn what's already available, send for PUB. EE-140B-W286.

What's new at Cutler-Hammer? Consistently first in supplying the aircraft industry with superior electrical control products, we have been introducing newer, even better products. We've added new engi-

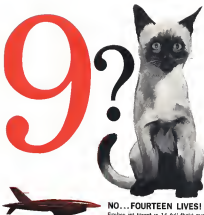
neering talent and increased plant capacity to help meet the tremendous demand of the service. Like to hear more? Contact the Cutler-Hammer sales office nearest you.

WHAT'S NEW? ASK...

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NO...FOURTEEN LIVES! The average "life" of a Ryan Firebee jet target is 14 full flight missions.* This means that one Firebee can do the work of 14 single-flight expendable dummies. And, with a flight duration of up to 1 hour and 43 minutes (Firebees have flown 1 hour and 17 minutes above 50,000 feet), Firebees are "on range" long enough to serve an entire squadron of supersonic interceptors or several surface-to-air missile batteries. After missile firings are scored electronically, Firebees parachute to land or sea where they are recovered for use again and again. Individual Firebees have flown up to 35 missions. No other target compares with the recoverable Ryan Firebee for high-speed, high-altitude reliability and low cost per target mission. Newest of the Ryan Firebee family is the transonic Q-3C, now in volume production for the Air Force and Navy. Air or ground launched, Ryan Firebees keep more service teams combat ready than all other jet targets combined. And, reflecting Ryan's decade of design and operational experience in the jet target field, improved Firebees will continue to test the mettle of men and missiles well into the Age of Space.

*Based on Q-3C operations at Air Force Missile Development Center

RYAN AERONAUTICAL COMPANY

DAY, OREGON • CALIFORNIA
Ryan Offers Challenging Opportunities to Engineers

November 21, 1960

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... Space Technology

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COVER: First Flight of USAF Thunderbolt with Avon Mk. 5 rocket engine in being tested for December launch tests Cape Canaveral. The Black Hawk on extreme left side of nose cone is a circular-shaped engine window for tracking. Dot on right side is telemetry antenna window. Rounder telescope between nose cone and third stage contains R&D test equipment used to trigger data stations that will be operational earlier. Thunderbolt for testing at base of engine; nose telemetry antenna. Flying along left side of third-stage casing is instrumentation survey.

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The national security need for Space Technology Leadership

Space is a medium in which many military missions can be most effectively performed • The U. S. arsenal of satellite missiles—in being and forthcoming—the Air Force Thor, Atlas, Titan, and Minuteman, the Navy Polaris, and the Army Jupiter, are all designed to deter the outbreak of a nuclear World War II or to retaliate overwhelmingly if it should occur • If our ballistic missiles are to realize their greatest potential in carrying out their dual task, they must be supported by a number of companion space systems. For such reasons as early warning, reconnaissance, communications, navigation, weather forecasting, Space Technology Laboratories is proud of its contributions to the national space effort as a principal contractor in carrying out major programs for the Air Force Ballistic Missile Division, National Aeronautics and Space Administration, and Advanced Research Projects Agency • The increasing scope of STL's activity is opening up exceptional opportunities for the exceptional scientist and engineer, who will find creativity given encouragement and recognition as an organization conspicuous with Space Technology Leadership. Resumes and inquiries will receive meticulous attention.

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EDITORIAL

The CAB Problem

One of the major problems that will be tackled by the administration of President elect John F. Kennedy is a new look at the mass of federal regulations agencies with a view toward speeding their actions and pointing their action, sharply at the current and future problems of the industries they serve. This would be in contrast to the backward looking agencies, that now make their decisions ancient history. In the past they are needed and contribute toward hobbling rather than helping either the industry involved or the public that uses it.

This problem has become particularly acute with the Civil Aeronautics Board which is dealing with an industry that changes so fast even its own management has trouble keeping abreast of technical progress and its economic impact. Former CAB Chairman James M. Lando, who has also had a distinguished career in other regulatory agencies of the government and a reputation for an incisive legal mind, has been working on this problem for the President-elect with a formal report due at the start of next year. *AVIATION WEEK'S* assistant transport editor David Hoffman, reporting from Miami Beach last p. 17, details many of the salient points of the Lando recommendations for streamlining the federal regulatory agencies and we think there will be few who will disagree with these major proposals and some who will hope Mr. Lando may be needed to apply them specifically to the CAB.

Lock of Experience Cited

One of the principal deficiencies of the agencies in they now operate, according to Mr. Lando, is the lack of experience by their board members in the fields which they regulate. This lack of experience has certainly been a major handicap to effective functioning of the CAB. There have been few Board members in the past 15 years who have had any practical experience in the air transport field and in recent years this trend has grown even worse.

On the present Board only Alan Reed has had flying experience, and it has been interesting to note his outstanding work even though he is one of the members of this august group. The CAB has become a convenient meeting place for political line ducks, faithful party hacks awaiting another politically appointive snore on the federal bench or an occasional bright young lawyer on his way to better things.

Clearly the time is ripe to change the character of the Board by adding some members with some valid professional qualifications in air transport as the terms of incumbents expire. The first step should come with the appointment of an outstanding new chairman to fill the vacancy that will be left by the expiration of the term of

John Brighton, highway expert and West Point graduate of President Eisenhower on Dec. 31. A knowledgeable and vigorous CAB chairman must be the key to any contribution this agency can make to an industry that is becoming increasingly entangled in the web of rising costs and falling load factors, overcompetition and costly increased seat capacity, and an increasingly complex pattern of jet traffics, interlarded with feeder operations and helicopter shuttles.

These problems are already acute (for details see *AVIATION WEEK'S* transport editor E. L. Doty's report on page 15). Now will they be solved by a single rising level of the general economy even if this prospect were in sight. These problems are here in the pattern of air transport in it is emerging in the jet age. They can only be solved by some fundamental reorganization of the entire picture, not as it now exists in the DC-3 era and bolstered by protocols of the past, but as it is inherently, determined by the trends that the present already indicates for the future. These problems involve not only the domestic route pattern but also the inter-continental scene where the combination of jet operational and sharpening appetites of foreign airlines are changing the pattern that developed in the last postwar decade.

Regional Concept Obsolete

The speed and capacity of jet equipment have also rendered obsolete the regional concept of air transportation and the approach to regulation and service problems based on that concept. Any change is a regional pattern with jet equipment now produces increases that are felt globally. Awaiting after things the CAB needs a broad perspective to the whole problem of the jet age and some pattern as a substitute for the traditional segmented regional approach.

Naturally, its procedures must be streamlined and speeded to permit handling of tomorrow's problems today rather than yesterday's problems tomorrow in the present pace dictates.

The domestic and international air transport pattern in the jet age is not only the sufficient reacting hammer to the fluctuations of the general economy today but is also a vital thread in the economic fabric. As such it deserves a regulatory agency staffed with sufficient expertise to understand and act on its problems and those of the public it serves and operating under procedures that will function with sufficient speed to be effective. Anything less than this will produce economic chaos and will increase the burden of federal subsidy in the jet age.

—Robert Hale



ENEMY LACK OF RECONNAISSANCE "PROTECTS" THE ALLIES AT GALLIPOLI

Gallipoli was a test for reconnaissance.

In 1915 the Allies struck at Gallipoli, intending to pierce the vital Dardanelles passage, capture Constantinople, remove Turkey as an effective fighting force and keep the shipping routes to the Russian allies. But the Gallipoli landings ran afoul of unrecruited misuses of the determined Turkish troops. The stalemate continued from April through December, 1915. Finally, the Allied high command decided to evacuate . . . quite a task when opposing trenches were often only ten feet apart! If the Turkish army should have an inkling of the evacuation before completion—if one effective reconnaissance flight were to examine the Allied disappearing attempts, it would mean disaster . . . perhaps the loss of more than 50,000 Allied troops.

But, while Turkish pre-war planning carefully built a large army, the generals ignored the value of recon-

naissance capability, thereby allowing an enemy force to escape intact. Allied planes, such as the Sopwith Baby, scanned the skies for Turkish and German moon plants. But none flew out to watch the muds. For five days troops and supplies were discreetly taken off and only 1500 Allied soldiers managed the bare against the entire Turkish army. And finally everyone had gone. Casualties 2 wounded.

The spirit and force resistance of the Turkish army had been revealed by lack of reconnaissance, a costly oversight.

From the breakdown of communications on the face of the earth, reconnaissance had helped shape history. Today GAI's primary in this was in looking ahead history to the advantage of the Free World. Typical of GAI contributions are W&P, Visual Infrared Presentation data display system (K&D) the world's most used the world center, K&D the only available system "available now" guidance system.

WHO'S WHERE

In the Front Office

Alfred L. McCarty, Moore attorney, a director of National Aerial Industries, Inc., filling the vacancy left by the resignation of R. F. Forman, the corporate secretary.

Booth Aircraft Corp., Wichita, Kan., has listed the following vice presidents as director: **Lobby L. Graves**, domestic sales; **Wynne L. Hays**, marketing; **James N. Lee**, engineering. Also elected a director: **A. R. Bell**, vice president-general manager. **Booth Aircraft Corp.**

William C. Windward, a director, National Electronic Corp., Van Nuys, Calif. Mr. Windward is president of Aero-Tec Corp., Inc.

Leonard C. Morse, president and director, Dahl Manufacturing Co., Roseville, N. J., a subsidiary of The Singer Sewing Machine Co., succeeding **W. D. Langley**, now listed chairman.

Allen B. Berk, president, Air Express International Corp., New York, N. Y., is succeeding **Charles M. Myers**, who continues as board chairman and chief executive officer. **Joseph C. Jones**, president and a director, The Electronic Corp., New York City, Calif., succeeding **Thomas H. Rhoads**, who now stays in a director.

M. Lester Mace, senior vice president planning, Research and Planning Department, American Airlines, Inc.

Robert L. Welch, vice president and assistant to the president, Radio-Television-Film Corp., Richmond, Va., is succeeding **W. H. Heller**, succeeds Mr. Welch in general manager of the Aeronautical and Instrument Division, Anaheim, Calif., and **Charles H. Venable**, succeeds Mr. Heller in director of field engineering and sales.

J. Clifford Matthews, Jr., vice president director of marketing, International Telephone and Telegraph Corp.'s Federal Division, Chicago, N. J., and **ITT Laboratories**, Valley, N. J.

Charles B. Rayburn, vice president in charge, management, Velpac, Inc., Falls Church, Va., and **William C. Fawcett**, Jr., vice president-engineering and manufacturing.

Alvin De Fries, E. Ray, assistant to the vice president, **Robert S. Davis**, technical advisor to the executive vice president and general manager.

John D. Blinn, assistant to the executive vice president, General Division of General Dynamics Corp., San Diego, Calif.

Alvin De Fries, E. Ray, assistant to the vice president, **Robert S. Davis**, technical advisor to the executive vice president and general manager.

Paul A. Pitt, vice president-engineering, John A. Searcy Co., San Diego, Calif., a subsidiary of International Electronic Co., also has been elected, manager of a new division which includes Searcy's aerospace ground support and industrial products.

W. M. Whipple, vice president sales, Ford Instrument Co., Long Island City, N. Y., a division of Sperry Rand Corp.

William G. Straus, vice president engineering, Martin Marietta, Inc., West Los Angeles, Calif.

Donald E. Berdich, vice president-engineering, Thermo Electronic Corp., El Segundo, Calif.

(Continued on page 112)

INDUSTRY OBSERVER

► Requests for proposals on **Defiant Air Command's STOL fighter** have been delayed about 50 days. Proposals originally were due Nov. 5, with contract award scheduled for early January.

► **Lockheed** has a small Air Force contract to investigate a nonrecoverable manned space station, or space ferry (AW Oct. 1, p. 56). Initially studied jointly with Hughes, the station endeavor while now is being investigated by the aircraft and spacecraft department of the preliminary design division of Lockheed's California Division. Company has made proposals based on its space ferry studies to Boeing for possible application to the Dryden program.

► **Evans Aeronautical Corp.** is developing a new version of the **Fincher target drone**, designated the Q-2D and designed to operate at altitudes up to 50,000 ft.

► **Bell Aerospace Co.** has designed a 50-passenger V/STOL aircraft in response to Air Force interest in a payload mosaic system. Large aircraft, such as the C-141, would serve a V/STOL aircraft or helicopter to the scene of an accident, extending the range of the normal B-1 and B-52. USAF also indicates the concept is feasible, but no formal design program has yet been launched. The V/STOL, now in partial models, would be powered by two turboshaft diesel propellers mounted on wing tips and driven by twin turboshaft engines.

► **Douglas Aircraft** is launching ballistic missile test and evaluation program will be conducted from Air Proving Ground Center, Eglin AFB, Fla.

► The three **Project Apollo** study contractors are to be forced to reconcile their completely different means to accommodate National Aeronautics and Space Administration's desire for three distinct approaches to the problem. Convair, GE and Martin all have approached Aerojet-General about participating in propulsion test subcontracts. Aerojet may be able to join two of the study teams by preparing a liquid rocket system for one, sold for the other.

► **Marine Corps** now expects to reach a decision in its ability helicopter competition in January. Winners are evaluating the **Sikorsky HH-35B** against **Versal** and **Model B-1**. Both are powered by General Electric T75 turbine engines.

► **Kennedy K-100** supersonic V/STOL aircraft currently is undergoing wind tunnel testing at NASA's Ames Research Center. Airframe is a Grumman Goose modified to a lifting-coupled configuration, and the V/STOL is powered by two GE T55-GE-2A turbine engines (AW Jan. 11, p. 12). Tests will be completed next month.

► **North American CRP-2** Mach 2 bomber will be fully dependent on a ground-powered hydraulic system to start its General Electric J55 engines. Launch will carry carriage weight for emergency starts independent of ground equipment.

► Contract for a 12-channel biological telemetry system, to be used as such vehicles as the X-15 and D-155, will be awarded soon to one of three bidders by Air Force Flight Test Center, Edwards AFB. System will have to be capable of transmitting a pilot's body temperature and g-force data responses, as well as electrocardiogram, photo-angiogram and electroencephalogram.

► **New 24-Wg** aircraft test will be designed for the **Convair 340** in a replacement Hughes Air Development Division is conducting. Flight test will be designed to better understand the aircraft and landing loads that have given the current 22 in. per second service life.



CHICAGO AERIAL INDUSTRIES, INC.

101 WEST NORTHWEST HIGHWAY, BARRINGTON, ILLINOIS • OFFICE, DAYTON, LOS ANGELES, WASHINGTON, D.C.
OTHER OFFICES: KATONAH, CHICAGO AERIAL SURVEY, South Park, Blue, PACIFIC OPTICAL CORP., Inglewood, Calif.

Soviet Export Drive

Soviet Russia continues to export fighter and transport aircraft and helicopters, making the sale an instrument of foreign policy by setting the pace to the customer's pocketbook—particularly if the customer is also interested in U.S. aircraft.

India and Russia now apparently have concluded an agreement under which Russia will furnish 5 to 12 An-12 four-engine turboprop transport in a modified model of the An-10 Uralian twin-engine turboprop. The agreement also includes 10 Mi-4 helicopters. India has bought two Sikorski S-62 turbine helicopters and has been considering the French Alouette III, but Russia now has beaten the U.S. and France as bidder who. India wants the helicopters and transports for operations over the Communist Chinese border.

Mexico also has accepted an offer of Soviet military aid that includes jet aircraft, U.S. satellites and so the form of trucks, jeeps and communications equipment is moving in Mexican use, and it is meeting strong opposition on the grounds that its acceptance will make the Mexican government politically indebted to the West.

Russian propaganda is increasing loud of the British-U.S. agreement to base Polish anti-aircraft submarines in Scotland. They are claiming that the U.S. is negotiating for similar servicing bases along the Arctic Coast on the Sea of Bering and in the Baltic Sea.

Military Space Limits

As France is telling industry leaders in hearings that military space extends outward from earth to 10 earth diameters or about 10,000 mi. Planning of weapons, defense measures and armed intelligence and logistic systems is based on this definition.

When the French adopted the term "cosmos" shortly after Sputnik I was launched, the implication was that it included everything from the ground up. With countries going into underground also and sub-orbital launching platforms under active Air Force consideration, a still more extensive term may be needed.

The increasing emphasis on space has caused still another name change within the office of the Deputy Chief of Staff for Development. This office has been redesigning studies and tele changes were reported. In its Directorate of Space Development headed by Maj. Gen. Martin G. Dunlap, now has been renamed the Directorate of Aerospace Systems.

USAF has stopped referring to its proposed tactical range missile as TSMX and TBM, in another attempt to clarify terminology. It has adopted the term NIRM. The title of NIRM, 10 mi. range, Specific Operational Requirement for a Mid-Range Ballistic Missile (NIRM) Weapon System.

The earth's only natural satellite caused a season race at the Ballistic Missile Early Warning System (BMEWS) station at Thule, Greenland recently. During initial operation of the station, radar signals suggested that the U.S. was under a near ballistic missile attack. Shortly afterward communications with Thule were suddenly cut off. But the radar signals turned out to be reflections from the ring moon and the own automatic tracking turned out to be a purely coincidental loss in a submarine cable caused by a drifting iceberg. BMEWS computers now have been told what the ring moon looks like.

Progress on Zeus

Special Nike Zeus study group created recently by Richard S. Maize, Area director of research and development (AWNS-14, p. 27), has completed its work and has announced a plan that would allow Area to learn a limited type of production before the Koppelman six wings at Atlas targets are completed. The plan calls for studying in technical changes in development programs.

Optimism is the order of the day in the Rocket section rocket engine program. The progress of nuclear power for spaceflight shows considerable gain in those close to the project, now has rocket engine and infrared computer research, entered and got its technical competitive (see p. 33).

Marta, Thales and Westinghouse are the apparent winners of the latest contract award in the program—studies on the development of test and production facilities required. Initial comparisons bid for this and more than half a dozen are expected to bid for development of the engine 400.

Severies of the Navy AT test center named National Aeronautics and Space Administration and Atomic Energy Commission to skip the production engine studies, finally getting on schedule. NASA, requests for proposals on engine development are expected to go before the end of the month, even earlier than NASA was previously. Some work is going.

—Washington Staff

SOME SILICONE RUBBER "FIRSTS"...WHERE YOUR SILICONES MAN PLAYED THE LEAD

The combined industrial and research facilities of Union Carbide Corporation, with tremendous resources of chemical experience and knowledge, have brought about outstanding achievements in silicone rubber. One of these contributions, which industry has enthusiastically accepted, are depicted on our film strip here.

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UNION CARBIDE Silicones Man first. Advantages such as low temperature flexibility, thermal and oxidation stability at very high temperatures; low compression set, erosion, wear, oil resistance; electrical resistance or conductivity. Your Silicones Man has them all at his fingertips. Write Dept. KA-5002, Silicones Division, Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. In Canada: Union Carbide Canada Limited, Silicone Division, Toronto 12, Ontario.

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UNION CARBIDE SILICONES



1. First with controlled viscosity and controlled reaction.



2. First with controlled viscosity and controlled reaction, making possible the film, flow, and other uses.



3. First with controlled viscosity and controlled reaction, making possible the film, flow, and other uses.



4. First with controlled viscosity and controlled reaction, making possible the film, flow, and other uses.



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Rand Reports Weather Satellite Benefits

By Edward H. Kellen

Washington—Research presented at the use of satellite-produced weather data has been discussed by Rand Corp. as the first of a series of studies on the social impact of space research.

Rand reports that there is significant economic potential in the improved meteorological information and forecasting that would result from satellite observations. Most of this potential lies in savings which would result from better planning and reduced storm damage made possible by better weather information.

These preliminary findings, backed by more specific evidence produced in Rand continues its study for the National Aeronautics and Space Administration, will furnish information for officials in the space agency, the Weather Service and other agencies as they effort to build a broad, integrated weather research and reporting program.

Initial Report

The Rand report is the first from the NASA's \$400,000 investment in a broad program of studies to determine the impact on nonmilitary fields of the rapidly expanding space research effort. These studies will produce the first significant non-technical data and opinion

NASA will have available for its decisions on national space research goals, policies and levels of effort.

The degree of influence the social scientists will have in going to depend on the policies of the new Kennedy Administration and on the recommendations of the new President's NASA administrator makes to him. Reports will be available from all current studies by the time Sen. Kennedy moves into the White House as President later in January.

Fiscal 1962 Budget

NASA plans to authorize the study program and its budgeting more than \$100,000 for it in Fiscal 1962. Areas to be studied in the next phase will not be determined until the next congressional session of the current studies is completed next month. This is a survey by the Rand Institute of the implications of peaceful space activity human affairs, and it is expected to outline the areas of space research expected to be most fruitful from a social and economic standpoint.

Headings they cover the effects of space research on economics, human behavior, domestic and international politics, national policy, potential hazards and the value of space research in the world as it is expected to be in the 1970s.

In addition to the Randings survey and the Rand weather study, NASA is sponsoring three studies:

- Government policy on communications satellites and economic aspects of such satellites. United Research, Inc., is conducting a five-month study in this area, and the Rand Corp. has a contract for a longer range study.
- Communications problems between the scientific community and NASA are being studied by United Research.
- Analysis of legal documents relating to space and a proposal for control of space activities is being prepared by the American Bar Foundation.

Jack C. Oppenheimer, executive secretary of NASA's long range studies committee and member of its program, and the communications aspects will be completed in January, and the Bar Foundation study is expected within the next several weeks.

Rand Studies

Rand is expanding its weather studies and is preparing a report on the economic effects of hurricanes. Rand also will report on the impact of improved weather information on air cargo operations.

While the Rand report predicts considerable economic potential in better weather forecasting techniques, it also warns that weather information will be valuable only if improvements are made in the means of communicating the best information quickly to those who need it to make decisions ranging from weather forecasts.

In one case history, Rand cited a 100-day study of the Los Angeles area and concluded that full use of currently available weather information could cut economic losses caused by weather by a third, and improved forecasting could cut losses another 30% if the action reaction were supplied efficiently.

In the study on weather information and its value to emergency situations, Rand also set considerable technical aspects of satellite weather forecasting but promises that future forecasting will improve over present methods. The immediate conclusion is that better methods of forecasting and making forecasts impending bad weather will mean fewer losses. For example, in aviation, in dividing flight routes and passenger loads, farmers, in crop choice, planting and harvest times, meteorologists in deciding whether to stop papers in protective wear paper.

Rand has closely measured economic damage pertaining to these specific industries to show that a framework can be established to establish the value of accurate predictions. Detailed

cost-benefit analyses are studied for trucking, specifically to determine whether to produce a cargo at a cost of \$200, or risk more damage at a cost of \$5,000. In an area having more rain than one of 100, Rand has arrived at these weather cost figures: \$300 per day to produce the cargo all the time; \$270 per day if the cargo is never produced; \$15 per day if the cargo is produced only when it rains.

Another picture showing, analyzing the difference in film orders or deliveries with outdoor shooting, having a \$1,000 higher value than indoor work. In this industry, accurate forecasts can show unnecessary costs of special lighting, modification of the day's work, or even completion of outdoor films.

Construction, which, about twice, is not so pronounced because a contractor normally can control his own work as payment of work has not begun because of bad weather. In the specific studies by Rand, a building project, versus attributed to perfect forecasts would be small.

Rand has indicated the first report a pilot study to provide a basis for future policy, through studies of improved forecasting and a rough estimate of its value.

The broad conclusion is that weather satellites will have value if they yield more or better information than current systems for a given cost, or if they provide comparable information at a smaller cost.

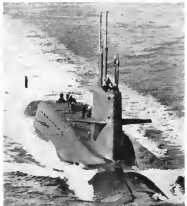
NASA feels that weather satellites can furnish better information than present systems. Test I, the first experimental weather satellite, already has shown that radio-satellite signals are identifiable from above in cloud cover signatures, and a catalogue of these signatures could provide the basis for new forecasting techniques.

Satellite Detection Shifted to Norad

Washington—Responsibility for satellite detection and tracking of satellites has been transferred from the Advanced Research Projects Agency to the North American Air Defense Command, in deciding that operation of satellites, left mechanisms quickly eventually be assigned there also.

The detection system was considered too rough along in development of defense technology to be transferred to an operating command. The transfer also is expected to eliminate some of the differences between Navy and Air Force, which have operated separate parts of the system for AFSA.

Satellite detection and tracking will be integrated with NORAD's missile and missile detection and warning system. Further improvements are ex-



Polaris Sub Heads for Sea Duty

USS George Washington (SSN-598), a U.S. submarine, is being hoisted by a crane at the Naval Air Station at Cape Canaveral, Fla. The submarine is being moved to the George Washington class, which is expected to be in service with its boats, the Forrestal, probably in January or February when a replacement one will take over. After replacement, the USS Forrestal Henry, will be deployed within a few weeks.

pected to include greater range and lower costs for the satellite tracking system.

Many components of the current system are the Space Force are still in the class of detection stations distributed across the western U.S. and operated by the Navy, with computing headquarters at Dahlgren, Va., and Space Force, which includes military and civilian tracking stations operated by Air Force, plus the USAF's own National Space Surveillance Center at

Cambridge, Mass., which receives, analyzes and catalogs space vehicle data from its own network and from Soviet information furnished, distributed to the world scientific community through the non-military satellite use will be handled by National Aeronautics and Space Administration under arrangements with the Defense Department, NASA, Communications and Aeronautics Coordination Board.

NORAD has responsibility for detection, identification and defense against missiles. It also operates the Ballistic Missile Early Warning System and presently will be given control of anti-missile missiles when they are developed. Transfer of the two detection missions to NORAD indicates that anti-missile missiles and anti-satellite missiles—such as USAF's—will be developed in the State and defense programs—would also be operated by this command in a continuing integration of the aerospace defense mission.

Dyno-Soar Communications Data Link

Los Angeles—Communications data link between the Air Force's Dyno-Soar boost glider vehicle is expected to increase one of the toughest environmental problems confronting communications with a space vehicle, namely the difficulty in transmitting through the plasma sheath which surrounds a re-entry vehicle. The answer to this problem may lie in the use of a new type of communication frequency band that lies within one of several possible "windows" in the spectrum. Communications engineers which transmit and receive on these frequencies may be able to penetrate the ionized layer created on re-entry.

For this reason USAF specified that companies which submitted bids on the communications data link submitted by Dyno-Soar had proposed programs in several frequency bands identified by the Air Force. Bidders were asked not to recommend utilization of any one of these bands, presumably because selection would be made on the basis of Air Force-sponsored studies of the physics of re-entry communications.

About 50 companies attended the original bidder's briefing on the Dyno-Soar communications data link submitted by 18 proposals were submitted for the \$10-15 million project (AW No. 14-23). Several of the proposals appeared from officials. For example, one bid was filed for a team composed of the Aerospace Systems and Surface Communications Division of RCA, Radio, Inc., and Space Systems, another by Motorola and Cook Electronics.

Antenna and ground equipment to be supplied will include the following:

- Telemetry down glides to ground. This would probably provide monitoring of vehicle conditions as well as physiological responses of the pilot.
- Rescue and recovery. This would include a rescue and a recovery to show that the vehicle can be landed at landing areas outside protected areas.
- Ground and airborne command transmitters and receivers for data and voice links.
- Airborne and ground signal processing, probably video, tracking gear supported by large ground tracking antennas.

Minuteman May Get \$1 Billion in Fiscal '62

Washington—Minuteman solid preflight reconnaissance ballistic missile, which the Air Force now considers its optimum strategic weapons system because of economy of production and operation, is scheduled to take a billion dollar bite out of the Fiscal 1962 USAF budget.

Projected spending was reflected in an Air Force announcement that the first Minuteman squadron would be in operation as July 1, 1962, a year ahead of schedule, at Minuteman AFB near Great Falls, Mont. (AW Nov. 7, p. 7). The squadron will have 55 missiles in underground silos within a 115-missile unit.

Minuteman packs less power in its warhead than the less expensive Titan II, which is in the early stages of development. But its lower cost of \$400,000 per launch compared with Titan II's \$4 million, its lower support

personnel requirement, and its readiness in greater numbers will result in reduced overall vulnerability and wider target selection.

Studies have revealed that development of missiles larger than the one now in development is not needed. Titan packs in big a punch in accuracy and Minuteman missiles in large numbers can obliterate most targets, the studies indicated. Only large follow-on might be a solid propellant booster to carry a Titan II solid warhead, making it a less complex weapon. Studies were conducted which contemplated capabilities of lifting payload packages weighing as much as 10,000 lb.

In submitting its budget requests for Fiscal 1962, USAF indicated the importance it attached to the Minuteman program by asking \$800 million in the lowest request of money—a budget totaling \$70 less than USAF received in

Fiscal 1961. If a budget of \$700 in 1961 more is approved, the figure USAF seeks will be \$1.05 billion.

In view of the enthusiasm of President-elect John Kennedy and Congress for an accelerated missile program, Minuteman is almost certain to be our mainstay for approximately \$1 billion, no matter what figure is submitted to Congress originally by the Eisenhower Administration.

USAF studies indicate that great numbers of cruise missiles would be required to knock out an equivalent portion of the ultimate Minuteman strength. Even firing by the score of several hundred missiles, cruise missiles of such weight and speed as the ICBMs of such weight and speed, with a high percentage of direct hits, would have to be estimated 3% of the Minuteman missiles ready to retaliate.

The cost considered to be the most realistic (unavailable), and it did not take into account other U.S. retaliation capabilities in aircraft, other missiles and sub-launched Polaris missiles.

Changing the degree of knowledge of heading after launch, naturally affect the survival rate and force substantial changes in course, plans regarding the number of missiles needed to deliver a secure blow. By making after launch a sufficient improvement of five pounds per square foot or less, warheads of little missiles in the thousands would be required for a 95% hit rate. However, if heading goes into the hundreds of pounds per square foot, and a slight positive error in accuracy is figured, the number of missiles required for a knockout blow goes to more than 10,000.

In advancing the operational date from 1963 to 1962, the period when Soviet missile numerical strength is expected to be at its greatest over U.S. strength, U.S. activities, power-including other missile and aircraft elements—will be expected to be capable of assuring a better-than-even exchange.

Future schedules for missile deployment call for operation of 18 Atlas squadrons with a total of 138 missiles and one Polaris wing submarines carrying 144 missiles by the end of 1962. This does not take into account the approximately level strength of the Strategic Air Command B-52, B-36 and B-47 bombers, and the attack aircraft already in service.

Economy in personnel is demonstrated by comparing the 500 men needed for a 55-missile Minuteman squadron—a little more than one man per missile—to the 600 men needed for a one missile Atlas squadron, which is about 60 men per missile.



USAF Launches Second Blue Scout

Air Force Blue Scout D-2, known in launch rail at F-15, Cape Canaveral, Fla., is the second of 12 test flights planned for several versions of the Scout vehicle (AW Nov. 14, p. 15). Second stage provides solid fuel for the test after a 280-mph. Note that the Scout is launched from a mobile launcher vehicle, not a fixed launcher. Note that the Scout is launched from a mobile launcher vehicle, not a fixed launcher. Note that the Scout is launched from a mobile launcher vehicle, not a fixed launcher.



Steepest climb distinguishes new Beech Model 55 Baron five-place, light twin business plane, powered by two light jet engines, 240 hp. Costs under \$10,000. Beech has a top speed of 250 mph., gross weight of 4,300 lb., cruise fuel of 1,923 lb. in 1,000 mi. cruise.

Beech Introduces Model 55 Light-Twin Baron



Instrument light capability of Baron is reflected in panel provision for 100 instruments and associated equipment. Costs cockpit group engine and propeller controls. Control wheel is of the three-spoke type. Cabin layout, at right, showing seating arrangement of 2-1-1 seats, is seen in working. Designed for low-level flight in areas of threat against air attack, the Baron has an excellent performance of 250 mph. in turbulence providing rates of 45 ft/sec. Large transparent area in cabin (below) provide high degree of visibility. Like comparison T-44, Baron's landing gear is positioned after that of Beech Bonanzas.



Discoverer XVII May Yield Sunspot Data

By Russell Hawley



DISCOVERER XVII CAPSULE trails behind F4U-119 which attempted it as second pass. The C-119's firing at lower altitude (below and left of capsule in top photo) would have attempted retrieval of the recovering aircraft had been unsuccessful. First pass by the C-119 was made at 12,000 ft, but was unsuccessful in engaging the capsule's parachute. Second pass was made by some reports at 9,800 ft.



Saneyville, Calif.—Final performance of the Agena B final stage of Discoverer XVII on its only orbit enabled USAF Satellite Test Center here to establish the duration of the test from 15 minutes to 15 and gather orbit data in experiments called probes to Aurora and Mads.

Scientific experiments being piloted by USAF included:

- Radiation contact and an attempt to capture micrometeorites in the lower part of the Van Allen belts and perhaps learn the correlation between sunspots and the aurora bands. The Discoverer XVII flight took place during a period of extreme sunspot activity.
- High-velocity light beamson tracked spectra to correct station set up by the Smithsonian Astrophysical Observatory. Data are to be used as a check on the accuracy of Navy Transit navigation satellites. Results of the experiment have already been called reliable.
- Biological specimens including artificially grown human cells, plant spores and bacteria. An industry official calls the biological experiments part of the device preparation for a Discoverer flight in which a module will be aboard the recovery capsule.

An overview of the Discoverer XVII mission capsule was the mission's successful attempt and USAF officers are becoming more openly optimistic about the future of the technique. Atlantic Missile Range officials are reported to have once set the probability of success at an encounter at "one in one million." A tracking and perfect vehicle performance.

Discoverer XVII was called the most successful mission of the Discoverer series by USAF officials. Vehicle performance was reported to be perfect and tracking excellent after the first pass during which radio transmissions from the orbiting Agena B final stage were weak and difficult to receive. Airfield control and extended homing during the recovery sequence were also excellent, as the 300 ft capsule left within sight of four of the nine F4U-119 recovery aircraft on station at the target area 500 mi northeast of Honolulu 10 min after ejection from the Agena B approach.

The alternate terminated and international range part of the recovery capsule parachute were first visually spotted at an estimated altitude of 30,000 ft. Capt. Gene W. Jones, pilot of the successful recovery aircraft, made his first pass over the parachute at 11-

Micrometeorite Belt Detected

Probes, Calif.—A belt of micrometeorites the size of dust particles is believed to surround the earth at altitudes between 100 mi and several thousand miles has been detected by Explorer 1, according to Dr. Albert Hibbs of Columbia University's Institute of Technology for Propulsion Laboratory.

Dr. Hibbs said: "A close examination of the Explorer 1 data shows a strong change in micrometeorite counting rate as the satellite changes altitude. The effect could be caused only by a cloud of micrometeorites in direct orbit around the earth." Dr. Hibbs explained that the dust particles come at from outer space and are described as highly elliptical orbits by the earth's gravitational field and the drag of its atmosphere. They remain in orbit for a few hundred or thousand years before falling into the atmosphere and burning up. They are not expected to be a serious hazard to space flight.

600 ft, instead, contacted a steep terrain, and returned for the successful recovery at 5,900 ft.

The events of the Discoverer XVII flight were exactly the same as those experienced for earlier Discoverer flights. Agena A spacecraft, made from the new group of experiments and tests made possible by the larger payload of Agena B. Agena B has a dual-burn capability to permit considerable changes to the first orbit established in the first phase and most any plans to use it in Discoverer XVII. During Discoverer XVII flight, special attention was devoted to engineering tests of the Agena B vehicle substation and payload system because of trouble experienced with that system as the Agena A vehicle of Discoverer XV.

The successful launch of Discoverer XVII from Vandenberg AFB was made with a modified Douglas SM-71 Thor booster. The modified rocket is end-mounted by USAF and is called DM-21 by Douglas. It is 10 ft shorter than the Thor boosters used to launch Agena A Discoverers and of space vehicle because of the change in the guidance computer section. No guidance computer is needed on the Agena B Discoverer. The DM-21 has the improved Black I Redstone engine used in late model Thor and will burn RL-44 fuel for the Agena B Discoverer except either two nozzles.

General Electric phenolic nylon first stage was used, the first time it has flown on Discoverer. This phenolic nylon type of first stage will be used on the forthcoming Discoverer which carry monkeys.

Aviation Week, November 23, 1960

House Group Asks Industry Help In Review of Rocket Programs

Washington—Industry has been asked to give the House Science and Astronautics Committee detailed help in preparing a review of current and projected rocket vehicle programs. The review is a part of the groundwork being laid for public hearings which the committee expects to hold early in the next Congress.

Companies are being asked to discuss 10 general areas of rocket development work. The committee is under considerable pressure to investigate certain specific contract money work over the next two years and to report to the Senate Committee on Appropriations and Space Administration or expected in the near future. In some cases, probing of the general subjects may form the basis for more detailed investigations.

Senate Committee on Appropriations and Space Science probably will be slower getting into hearings as the 1970 Congress because it must be assigned a new chairman. Vice President Hubert H. Johnson has said he will not resign as Senate Democratic majority leader until shortly before he takes office on Jan. 20. Johnson was chairman of the Senate space committee in the last Congress, and its continuation will be delayed if he does not resign until close to the 39th.

The Senate committee is expected, however, to release a report on space work before Jan. 1. The committee's staff also has completed a review of the report on the potentially controversial subject of police planning for space communications. Although the report contains no political implications, it will be released in the near future because committee members did not have time to review it. A third report which is a factual summary of the Saturn space booster program, also has been prepared, and its completion is hoped that these also can be released before Jan. 1.

The House study of rocket development will assist first in a preliminary report. In preparation includes visits to a number of rocket engine and airframe plants by Cook Howell Jr., Subcommittee on the various research activities assigned to the committee for the year. Subcommittee's previous study report was in the form of a report to the Office of the Chief of Naval Operations.

Aero, Navy, Air Force and National Astronautics and Space Administration are meeting in the review. Companies have been asked to discuss their 10 areas of rocket work.

Value of liquid rockets vs. that of solid rockets for use as large space boosters.

Application of atomic energy to space boosters.

This may go into the question of whether the Rover nuclear rocket engine now being developed by NASA and Atomic Energy Commission should be used in a first stage or only for upper stages. It also opens the way for questions on which companies will develop and produce Rover. Rocket Development of North American Aviation, Inc., now holds the contracts for all the large liquid space vehicle development being done by NASA and also has done considerable work on early Rover test engine components. Contractors for Rover will be selected within the next few months and Rocketman's competitors can be expected to fight hard to keep Rocketman from getting this contract.

- Hybrid rocket vehicles, such as combinations of liquid, solid and atomic stages.
- Whether proper booster are being developed to handle specific space payloads.
- Significance of booster simplicity and reliability in determining cost of project cost and program success.
- Feasibility of recoverable, reusable boosters for manned flights.
- Need for development of a family of space boosters not connected with institutional space development.
- Need for an integrated, well-defined launch vehicle development program for both military and civilian use.
- Availability of current space vehicles to meet each company's program requirements.
- Booster designs in it affects payload design from the standpoint of reliability, cost, environmental criteria and weight, etc. useful payload.

The House committee, which had 26 members this year, will have at least 60 new members next year. Reps. A. D. Barnhart (D-Ohio) and Erwin M. Mitchell (D-Cal.) will not run for reelection. Reps. James O. Eastland (D-Miss.) and Leonard W. B. (D-Texas) and Edward R. Roybal (D-Cal.) will be re-elected. In addition, there may be some resignations due to the Republican gain in House seats. The committee's report probably will make more an area of subcommittee to explore particular areas. It is expected to review the entire space program, paying particular attention to current space flight and to development, develop new conflict between civilian and military programs (AW Nov. 14, p. 27).

Defense to Operate Geodetic Satellites

Washington—Defense Department has assumed responsibility for the geodetic satellite program in a direct administrative transfer from the National Aeronautics and Space Administration.

NASA suspended all work on the project last August (AWM Aug. 22, p. 32) pending a determination of whether it was to be a civilian or military program. Unmanned satellites consist of the Defense-NASA Aeronautics and Astronautics Coordinating Board, headed by NASA's Dr. Homer E. Newell, Jr., determined under this month that the military program was the proper one.

From a military viewpoint, the satellite has the potential to fix with great precision the location of any possible target by triangulation of simultaneous height measurements from ground stations of the high-precision signals which will reach from the satellite.

NASA said it could conduct the program only if the data obtained could be made available to the scientific community throughout the world. The request had planned to use the geodetic satellite to establish more accurately the shape of the earth, locate and map points of change, resolve mass mass and establish the gravitational fields of the earth's interior.

Defense has not assumed specific service responsibilities for the geodetic project, but the defense probably will be made to give partial responsibility to the Army—which handles mapping work for the Defense Department—and launching responsibility to USAF.

NASA Will Request Active Satellite Bids

Washington—National Aeronautics and Space Administration is developing an active/passive communications satellite program which may go to industry as early as next month in the form of a request for test flight bids—new design proposals.

Active/passive communications system proposed by Hughes Aircraft Co. (AWM Oct. 17, p. 26) already has been evaluated by NASA, but the agency now the project was entirely computer-aided and a contractor for NASA's active satellite will be selected on the basis of data on the project.

Even if specifications are issued by next January, it is not likely that NASA will commit money to the program until it is approved by Congress under a special emergency NASA funding authority. The NASA appropriations bill for fiscal 1968.

Special category includes 510 million

X-15 Flies With New Engine

Edwards AFB, Calif.—North American Aviation X-15 powered by its new Reaction Motors XLR99W01 engine (AWM Oct. 24, p. 30), approached Mach 3 and reached an altitude of 10,000 ft. with open boosters open and engine at full power during its first successful test flight last.

Delays have plagued the testing of the new X-15. First major on which design performance levels of the X-15 are based, altitude flight was the most difficult. However, North American test pilot Scott Crossfield and his helmet the new engine will enable the X-15 to exceed design performance of Mach 6 speeds and altitudes over 200,000 ft. The next test may be scheduled within a week.

A North American spokesman said the XLR 99 engine was developing 35,500 hp thrust at sea during the test and will reach a maximum of 42,000 hp. The engine has an exhaust nozzle and liquid oxygen, a 4 in. dia. long, 40 in. in diameter and weighs 993 lb. Crossfield reported that boosters came off at 17 sec after ignition during the take-off test. At full throttle, fuel consumption will go up to about 10,000 lb. per minute and boosting time will be cut to 90 sec.

The drop of the X-15 from the flying 83,500 ft. was about 10 sec. The drop of the X-15 from the flying 83,500 ft. was about 10 sec. The drop of the X-15 from the flying 83,500 ft. was about 10 sec.

The X-15 which made the successful flight was the number two airplane, which previously had its boosters during an emergency landing due to an engine fire.

to land projects considered against. The loss of any money is obligated, however, NASA must justify the project. Its cost and reason for agency to have made the project. NASA Administrator James H. Doolittle has said the space agency is planning an early flight to demonstrate feasibility of an active satellite, but the NASA program will not duplicate Defense Department's current and active satellite efforts. Following Doolittle's statement, Congress said it plans legislation to ensure that duplication between NASA and Defense does not exist in communications from large booster and manned space flight projects.

W. Va. Jackson, a West Pointer who was decorated 19 times in a fight in World War II, formerly was a legal and engineering consultant to General Electric Co.

At Prince will order three more long-range Boeing 707-120s powered by Pratt & Whitney J44 turbojet engines, bringing its total Boeing fleet to 26 airplanes scheduled for February-April, 1965. At Prince also is buying an order: Carrietta (AWM Nov. 7, p. 41).

Army-Martin Douglas fielded range ballistic missile fleet 150 in over the Atlantic Ocean. Douglas lost one in the first fully successful test of both of its Thorball and perigee-powered stages. Launches were made from a prototype transporter-erector-launcher and the one-stage was supported, but no attempt at recovery was made.

News Digest

Second flight of an Avco M-34 M-34 2-1/2 mile vehicle aboard a USAF Convair A-10 was made over the Atlantic Ocean Range last week. A jet engine, which was the same as the one used in the first flight, was used in the second and recovered 1 hr, and 54 min after launch by an Air Force M-34 test carrier over range vessel, the Thunder Hawk.

Convair-F-105. Worth was chosen last week to build the main wing box for the F-105 Mach 3 bomber under contract to North American Aviation.

Carl Nelson P. "Pete" Jackson (USAF aviator), Washington representative of the Jay Manufacturing Co. and president of the National Retail Club, and Roger S. Bell, formerly with Latham Industries, were killed last week when a Norton-Dow by Jackson crashed into a mountain near Reno, Nev.

New Electronic Effect

New York—Discovery of a new electronic phenomenon, which promises a major advance in satellite communications and microwave technology, has been reported by General Electric. GE scientists have discovered that the tunneling phenomenon, which occurs in semiconductor materials, also exists in two metal films separated by extremely thin insulator at most absolute zero temperatures. The discovery opens the way to an extremely linear electronic device, which could produce a variety of advanced electronic systems, including rectifier, diode, triode, and other devices. New superconductive tunneling devices may prove as significant as the development of the transistor, a GE official says.

AIR TRANSPORT

Lowest Trunk Earnings in Decade Forecast

Earnings may fall below \$4 million level in 1960, following declining trend of first three quarters.

By L. L. Dots

Washington—Sharp drop in domestic trunk airline profits during the first nine months of 1960 compared with a similar decline in the rate of traffic growth may depress year-end net earnings below the \$4 million mark, the lowest level since 1949 when the industry turned its first postwar profit.

Earnings which will be reported by the 12 trunklines for the first three quarters of the year are estimated by Aviation Week at \$3.6 million, compared with \$5.1 million net profit registered during the same period last year. Since fourth quarter business is most weak historically but produced only a slight profit if any, and since October traffic showed no predicted improvement over the weak record of the past five months (AWM Oct. 24, p. 32), the \$3.6 million figure now stands as the 1960 industry profit.

Net earnings last year were \$60 million. Highest profit level ever reached by the 12 trunklines was \$63.1 million in 1955. First postwar annual profit was in 1949, when the scheduled domestic trunklines reported net earnings of \$15.5 million.

Low freight spots appear in the overall economic picture of the industry to create some time for optimism this year. Revenue passenger index for the first 10 months of the year climbed only 5.4%, estimated with the 13.14% increase considered normal for the carriers as growth continues. Cargo traffic, with its lower revenue yield, continued to play a damping role as the business volume, although first class traffic inched slightly ahead of such revenue passenger miles in October, the first month in which this highly revenue traffic has been in first rank last year when cargo traffic took the lead (AWM July 18, p. 59).

Catch Growth Continues

Cargo traffic continued to rise steadily in October, however, with a 24.9% increase in revenue passenger miles over October, 1959, compared with a 9.0% decline in first class revenue passenger miles. Lead factor for cargo traffic was 61% during the month, compared with 57% for last month, 60.1% for all traffic. Seven of the 12 trunklines did show a net profit in the first nine months, although, with few exceptions, earnings were substantially below those reached last year. The net profit of \$12.9 million estimated for these seven carriers was all but erased by the heavy losses incurred by Capital, Eastern, National and Northeast.

Trans World Airlines will show an estimated loss of \$195,000 on its domestic operations for the first nine months, but revenues from its international operations, particularly from overseas services, will give the company a net profit of \$600,000 for the period. All but \$4,800 of the airline's net was produced in the third quarter.

The airline's slight profit increase posted increases in gross revenues, but the losses were not sufficient to offset the continuing upward trend in expense levels. In addition to normal cost increases, harbor transitional expenses have again deepened losses.

In example, Delta Airlines reported expenses averaged 22% of its third quarter net over the same period last year, compared with a 21% gain in gross revenues. Disposition and amortization charges declined 9% during this period.

Generally, the rising trend of cost costs does not appear abnormal in view of the overall economic situation. If any net costs have been needed to keep high, they are not unique and are not uncommon, an understandable reaction to the anticargo in turbine equipment, and in passenger service, an increase that has been free of competition within the industry. During the last six months of 1959, net costs in three categories climbed 10% and 17% respectively over the same period last year.

Most airlines are faced with extraordinary increases in interest costs. American Airlines, which will report an earnings from operations of \$6.9 million, reported an interest and amortization expense increase from \$68,000 during the first nine months, 1959 to \$1.1 million in the same period this year.

American reported a \$770 increase in revenue passenger miles during October to maintain a steady margin, but its traffic decline, which reported a net loss for the same month of \$5.7 million, an all operations and a \$5.6 million loss in domestic services only, still shows a 13% drop in revenue passenger miles during October.

Eastern reported a drop in operating revenues of \$3.9 million during the last six months of 1959, compared with the same period in 1958. The airline's total net income in \$4 million loss in gross revenues to a \$1.4 million profit. In cutting losses, the airline was able to show a 51 point gain in load factors despite a 17% decrease in revenue passenger miles.

Eastern also apparently has suffered from a drop in revenues in Florida markets. Daily airlines to report October load factors below the 90% level were the three which compete in the market along the East Coast-Eastern, National and Northeast.

First Class Increases

Norfolk, however, was one of only three carriers to report an increase in first class revenue passenger miles last year. The airline reported a 30% jump compared with 11% for October and 19% for Delta. All other trunklines showed a drop in first class traffic volume.

On the other hand, Northeast and National were the only two trunklines to show a decline in such revenue passenger miles last month. All other carriers gained in this category. United led the group with a 45% increase in first class revenue passenger miles. Performance this year is reflected in the carrier's report to its shareholders for the third quarter. Net profit of \$7 million was the highest for any quarter in the carrier's history. Net profit for the third quarter was \$9.7 million, including revenues earned on the six-hour Houston route.

Western Air Lines, which reported a total profit of \$2.1 million, showed a decided climb in expenses and a revenue increase that left little of early harvest. Higher expense level was attributed to increased depreciation charges, additional costs related to the shutdown of the Lockheed Electra and the increased costs involved in the introduction of turbo-propelled aircraft. Depreciation and flying equipment



Swing-Tail Canadair CL-44 Makes First Flight

Canadair CL-44H turboprop transport made its first flight last week at Montreal, Canada. The engineering test flight lasted 1 hr 28 min. Flightpath (except port forward) of tail over the wingtip (AW Sept. 5, p. 36). Payload is more than 66,000 lb. Port winged CL-44H is the fourth aircraft of the CL-44 line. The remaining eight are sub-leading CL-44-500 aircraft for the Royal Canadian Air Force. These U.S. cargo have been ordered by CL-44-500.

aircraft in the same month period totaled \$7.9 million, against \$4 million in the 1959 period. Increase includes \$1.5 million from accelerated depreciation of Western's Douglas DC-6B fleet.

During October, Western showed a 10% decline in first class revenue passenger miles and a 23% increase in coach traffic. The change is reflected as the carrier's 24% cut in the volume of first class available seat miles and a 21% increase in coach available seat miles.

Continental Air Lines reported the

first class month period in its history. Gross revenues of \$45.7 million were 44% above revenues in the same period of 1959. Net operating profit was \$1.9 million, an increase of 10% over the operating profit for the first nine months last year.

Continental's revenue passenger miles reached a total 46% higher than the volume produced in the first nine months last year. In October, however, Continental's revenue passenger miles dropped 13%, and revenue load factor fell from 57.6% in October last year to 54% this year. Coach revenue passenger miles jumped 27% in October, compared with a 5% dip in first class revenue passenger miles in the same period.

Briffault Boosts Coach

Briffault Airways got new impetus in coach service with a 127% increase in coach available seat miles to about 1.6 million available seat miles, compared with a single 1.7th last year and generated a 18% increase in coach revenue passenger miles. First class revenue passenger miles fell 10% in October, and there was a 12% decline in first class revenue passenger miles. Briffault will report an estimated \$812,000 net profit for the first three quarters of 1960.

Northeast will show a net profit for the same month period, although the carrier has had a recent traffic decline. The airline's Douglas DC-8 turboprop transport fleet was grounded by labor trouble for about half of October, cutting into the traffic decline. Revenue

passenger miles in October dropped 10%, and available seat miles went up 6%.

For the first 10 months this year, first class revenue passenger miles for the 12 airlines fell 4% and coach revenue passenger miles rose 15%. First class available seat miles climbed 1%, coach available seat miles increased 19%. First class load factor for the first 10 months for the industry was 57%, compared with a 64% coach load factor.

In October, only five carriers out of the 12 had an increase in revenue passenger miles in all categories of passenger traffic. Six carriers reported an increase in available seat miles for the month, inefficiently offsetting cuts by the remaining six to produce an industry increase of 4.8% in available seat miles.

Pan American Reports Profit, Revenue Gains

New York-Pan American World Airways reported a net profit last week of \$2.3 million for the first nine months of 1960 on total operating revenues of \$310.6 million.

Net income after taxes in the first nine months of 1959 was \$1.5 million, and revenues were \$250.5 million.

Passenger revenues for the 1960 three-quarter period totaled \$248 million, a 20% increase over the \$206.8 million generated in the same period last year. Net income in the third quarter amounted to \$5 million, compared with \$3.5 million in the third quarter of 1959.

Landis Urges Speed-Up of CAB Case Flow

By David H. Hoffman

Missoula, Mont., 75th Congress president and leader in White House pressure will accelerate the flow of cases through Civil Aeronautics Board a Presidential aide John F. Kennedy insures the recommendations of James H. Landis now arrive.

Landis, for two years dean of the Harvard Law School and a former CAB chairman, has undertaken a study of federal regulatory agencies at the request of Sen. Kennedy. "We'll advance last week, this study is scheduled for completion in mid-December," Landis, here for the Air Line Pilots Assn. convention, presented some proposals to make administrative agencies more efficient, less cumbersome and less costly. "All but one could be applied to the CAB," Landis pointed out.

• Tightening up the rules of evidence that govern what can and what cannot be introduced at an agency hearing.

• Delegating most power to executive, giving them clear-cut authority to rule without "advisors" or "ad hoc" committees.

• Requiring interested parties to accept government's proposed plan, the 61-year-old attorney told American Airlines.

What that during his tenure as CAB chairman in 1949-51, Landis and his staff were composed of the most capable, highly trained, and best of the CAB staff.

Landis' report to Kennedy probably will contain another recommendation.

TWA Fund Talks Go On

Negotiations over continuing last week between Howard Hughes, on one hand and the Bank of America and Henry Crown, former chairman of Metropolitan Bank Corp., on the other as an active financing plan for Trans World Airlines.

Metropolitan is now owned by General Motors Corp., from which Hughes has obtained \$60,000,000, but Crown holds the funds subject to many other conditions. It is a director of the former State Building in New York, chairman of which is Fred Ginn, mentioned earlier in a candidate for the TWA presidency.

The active financing would involve some immediate payment from Hughes Trust Co., which was not of TWA's per cent and loan it to the airline (AW Oct. 18, p. 10), but will not take TWA's long term financing problems. Hughes says other than the last one, any part is expected under the agreement.

aimed at restricting the right of appeal from decisions reached by a committee. If the step is taken, Landis said, disinterested parties could not "appeal automatically" administrative hearings before the full Board.

To hold down the number of cases expected appeals to the Board next week for the consideration of more important questions, Landis suggested that the agency be given certain power similar to that exercised by the U.S. Supreme Court. This, in effect, would give CAB the right to set aside appeals while awaiting a decision.

Despite his guarded discussion, Landis frequently is mentioned as a possible Kennedy appointee to the CAB. Asked whether the President-elect had offered him such a post as the new administration, Landis last week replied, "No, and I hope to go to Washington."

But he did not answer whether he would accept such an appointment if Kennedy should name him to the CAB. Should Landis return to CAB, in place of J. S. Braden whose term expires on Dec. 31, he probably will use his office to help to speed up the CAB's case flow.

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The Southern Transcontinental Case, Landis estimated, stands for cost between \$10 and \$15 million, without including government expense in administering it. It is a complex case involving a large number of interested parties.

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FINNAIR'S CARAVELLES bring jet transport loads to Le Bourget Airport near Paris. Carrier started Caravelle service last April.

Caravelles Boost Finnair's International

By Edith Walker

Helsinki-Toronto Aero Co.'s, the Fin's new carrier, reports a 15% growth in traffic on its international route network for the first half of this year as compared to the same period last year, the introduction of its first three Caravelles jet transports on Apr. 1.

During the first 11 months of operation, Finnair Caravelles carried 17,800 passengers at 70% of the company's

total international traffic, a result which ranks among the best so far achieved by any medium-range jet transport operator. By the end of June this year passengers transported by the three Caravelles totaled 75,000.

Convenient connections from Helsinki to most major European centers are attracting an increasing number of passengers, but the rivalry in Caravelle flying has been compared with Finnair's fleet of piston-engine Conquest 440 as

still previously used on all the international routes in the chief contributing factor to the airline's good progress. Compared with the Conquest, Caravelle services from Helsinki to Helsinki, for example, cut flying time by 1 hr. 35 min. from Helsinki to London by 2 hr. 35 min.

Most important Caravelle route trip services are:

- Helsinki-Copenhagen-Frankfurt once a day.
- Helsinki-Hamburg-Amsterdam once daily.
- Amsterdam-Paris three times a week.
- Amsterdam-London four times weekly.

Longest route to Finnair's international network is from Helsinki to Paris or London, approximately 1,395 mi. Flight schedule for the Caravelle services is as follows:

- **Tokyo from Helsinki** at 7:30 a.m. one hour earlier according to Central European time; arrival Frankfurt at 10:15 a.m.
- **Departing from Helsinki** at 8 a.m., arrival Amsterdam at 10:55 a.m.
- **Aircraft leaves Helsinki** at 8 a.m., arriving in London at 11 a.m. or in Paris at 12 noon.

Finnair's fleet consists of nine DC-7s, six Caravel 440 Metropolitan (three of these are Conquest 440s purchased in 1955 and later converted to the Conquest 440 configuration), and three Conquest 440s. The company has an option on one more Caravelle for possible international network extension by 1967, particularly to Zurich.

The strong competitive position of



SLINGS down by random seat slings and other trends displaying from Douglas DC-7 at the Reims Airport in England.

Traffic Growth

other carriers using Caravel Airport is a very low load factor for 1959. The company's total 1.5 a.m. operator consequently had to discontinue its former Metropolitan service using flights via Caravel to Frankfurt-Cologne-Helsinki. It was hoped to return Caravel flying rights to Zurich by next year. An additional Caravel 440 is also to be put into service on its longer domestic routes.

Present utilization rate of the airline's DC-7 fleet is 75 hr. daily, usually at 8 hr. per day. Prior to introduction of the three Caravelles, the Caravel flew an average 8 hr. 20 min. daily. Present utilization rate has not yet been determined for the Conquest, but it is still fairly high.

To maintain such a good schedule as well as the accident-free record, Finnair has installed one of the most complete maintenance and overhaul systems. Two of these full-time mechanics are employed at all airports within the airline's main structure, where stop-over on its aircraft during the day or night is sufficient to allow a part of the servicing to be carried out.

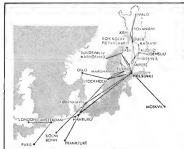
Normally, two mechanics work on the DC-7, up to three on the Conquest 440. Work is started immediately after the plane is parked and, by the time it takes off again at least four or five hours out of a total of about 50 per aircraft can be checked off the work sheet. This method has reduced Finnair's delays through servicing to an average of only 1 to 4 hr. This compares favorably with the record pro-



ROLLS-ROYCE Jet engine engine is being checked at Helsinki Airport facility. Major overhaul and maintenance is performed at Rolls-Royce shop at Derby, England.



ARNDPLOT D12 and Finnish Caravel 440 are shown at Helsinki Airport. Finnair's home base. Finnair serves Moscow twice weekly and Aeroflot flies to Helsinki four times weekly.



DOMESTIC and international routes flown by the Finnish carrier are detailed above.



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tion of giving each aircraft a thorough check and overhaul after 100 flight hours, which can keep it out of service for anything up to five weeks.

On the basis of one flight hour, the DC-3 requires 39 man hours of servicing, the Conquest 440 37. Calculations have not yet been made for the servicing of Finland's Caravelles. General instead of the job is done at the airline's own workshop at Helsinki Airport, but their Avon engines are maintained by the makers, Rolls-Royce, Ltd. at Derby, England. Also London, manager of Finland's maintenance and overhaul at Helsinki, explained that it costs not much cheaper to have the Caravelle powerplants serviced where they are made, compared with the cost of getting up a complete crew of engine overhaul workshop at Helsinki.

London, who has been concerned with aviation since 1933 and was one of Finland's first glider pilots, has been in charge of the Finnish carrier's main business and overhaul since 1948. He is also responsible for pilot training. Finland's maintenance staff, including engineers and mechanics, totals about 460, all at Finnish airfields. The workshop carries a constant supply of 68,000 different parts and spares representing a value about \$5.75 million.

The DC-3 fleet which Finland bought from the Western Allies after World War II, serves domestic routes exclusively. The aircraft are now being phased out gradually and replaced by Conquest 440s as larger carriers at some of the smaller airports, particularly in the remote north of Finland, are equipped.

There are a total of 39 airports in Finland, of which three—Kaukas, which is also a Finnish air force training center, Keuruu and Lappeenranta—are not only for Karhu, the biggest of Finland's few charter companies.

The other 36 airports covering a distance of 3,872 miles provide routes constitute Finland's domestic route network. The most difficult of these, located mostly in the less populated lake and woodland areas of the country, are served by DC-3s on a non-scheduled round trip basis. Helsinki-Lapland, started about 1951 on the Arctic Circle and the most northerly airport of all, is served at least once daily from Rovaniemi during Finland's short summer period, although several other airlines now additional DC-3 flights to each both ways. During the winter months, the service is less than weekly.

Both DC-3 and Conquest 440 flights connect the remaining nine larger airports with Helsinki twice and at a few cases three times daily both ways. On Nov. 3 this year, Rovaniemi Airport in northern Finland's Lapland, which is a round trip service via Oulu, the last part of Finland and Norway.



SINCLAIR Douglas DC-3 and Conquest 440 single-engine flight service under the population of Lapland to end the daily drive at the time that is people in Helsinki.

By steadily improving existing facilities and gradually establishing additional airports, particularly in the thinly populated northern portion of the country, Finland is helping considerably in promoting tourism. The airline industry, too, which is Finland's chief export commodity, is being boosted by cross foreign lines like to take advantage of Finland's well placed airports and one-way flight schedules between the various industrial centers to conduct the tourist business. Later on, the airline hopes to establish a new service from Helsinki north to Helsinki in Norway, where a large pulp factory is being built.

On Nov. 2 this year, Finland introduced a new round trip four times weekly Conquest service via Stockholm to Oslo. Other international Conquest services include Helsinki to Stockholm and Oslo and Stockholm via Copenhagen to Cologne three times a week both ways.

The Finnish carrier was the first Western airline to introduce a service to Moscow, and it was a personal offer there in February, 1955. It connects the Russian capital with Conquest 440 three times weekly round trip flights twice a week. Aeroflot, the Russian airline, flies to Helsinki via Leningrad four times a week both ways, using either D-17 or D-14 aircraft.

At present, Finland has a staff of about 1,450 including 100 pilots and 50 co-pilots, all Finns.

To qualify for service with Finland, however, must speak at least one language but none of them are those in the Finnish-Swedish-English-German and Finnish.

Most of the airline's pilots come from across the globe and the Finnish no doubt, a few, are private pilots that all possess their pilot's license when they join Finland. Instructions in the handling of civil transports take about a year. The carrier's flight school is a private group for the three types of aircraft in service with Finland: Caravelle flight crew

and technical personnel receive additional instruction at Sud Aviation's training center in Toulouse, France. Pilot licenses after five training with 12 flight hours then get further training in the Caravelle.

Finland's vice president of operations, K. J. Tienari, told Aviation Week that instead of three pilots, which is the normal practice with other airlines, his company's Caravelle flies with only two. In his experience, he said, the two pilots remain for more alert and "on the job" than when there are more men in the cockpit apt to distract the chief pilot's attention.

Tienari believes that end transports of the future will be capable of flying at around Mach 3. Apart from later versions of the Caravelle as a future addition or replacement in Finland's fleet, Tienari is studying the development of such types as the Boeing 727, British Aircraft Corporation's 107, de Havilland's 121 and the Conquest 660.

On Nov. 3 this year, Finland celebrated its 75th year of aviation. It is 1955, its centennial turned 75th anniversary on Oct. 17 got off to a modest start in 1925 with a short London-Finland one-way journey on credit and a staff of three. During the first year it carried a total of 398 passengers and flew 10,528 mi.

Although still a small carrier compared with most of its competitors, Finland has shown a steady growth throughout the years. Passengers flew, for example, on the company's domestic routes in 1950 totaled 294,769. Passengers flying on the international network in 1950 numbered 117,803. Gross revenue increased 5% in 1950 compared with 1949 and the company paid its shareholders a 6% dividend.

Based on the interest in Finland's international traffic, once it introduced its Caravelle jet streamers this spring, the company expects record over all results for the current full year.

From submarine base to target, the average life of the Polaris missile is 20 minutes. During that short time, the Polaris zooms along at 10,500 mph. And, with perfect precision, hits its objective up to 1200 miles from the launching site.

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20 MINUTES TO LIVE

Soviet Air Market Shifts With Growth

Moscow—Completion of Aeroflot's business is changing markedly along with the rapid growth in the Russian carrier's initial traffic, with passenger traffic scoring the biggest gains.

Before and after World War II, the Soviet airline's business was predominantly mail, cargo and freight. But passenger traffic is now moving into a position of overwhelming predominance.

The Russian Seven-Year Plan (1958-1965) calls for passenger rates to increase to seven times the 1955 level and the number of passengers carried to increase six-fold. Cargo tonnage is slated next, to rise 400% in the same period.

In 1958, passengers represented 43% of Aeroflot's traffic, and cargo was 42%. By 1965, passenger volume is to increase to 65% and cargo is expected to drop to 32%.

Proportion of total Soviet airway passenger traffic seemed to set a record to jump from 5.1% in 1955 to 54.6% in 1965.

Air Taxi Operator Requests New Routes

Washington—TAG Airlines, an air taxi operator, asked the Civil Aeronautics Board last week to amend its application for a certificate as a scheduled air carrier to include additional routes.

TAG, a division of Miller Oil Co. of Detroit, has been operating as an air taxi operator as a scheduled local flying firm (Detroit to Chicago and Detroit to Cleveland). Last February, the carrier asked the Board for a certificate to operate scheduled transportation of passengers, property and mail between the same three cities.

Last week, the carrier filed with the CAB for the following routes: Chicago-Cleveland-Cleveland-Pittsburgh, Cleveland-Greenwich, Greenwich-Pittsburgh. TAG operates a fleet of four de Havilland Doves carrying nine passengers each.

FAA Appoints Group For Medical Advice

Washington—The Federal Aviation Agency's Civil Air Surgeon Dr. James L. Goddard has established an 11-man Medical Advisory Council to advise the agency's Bureau of Aeronautics Medicine on policy matters.

The 11 men, all doctors practicing in aviation medicine, will meet twice a year in Washington to confer with and

advise the civil air surgeon on matters of policy and exchange views with the FAA on selected problems of aviation medicine. First meeting is scheduled for January, 1961, and Dr. Goddard will preside as chairman.

The council will later elect a chair man from its ranks.

The 11 doctors on the council are Dr. W. F. Ayer, Jr., chairman of the Department of preventive medicine and professor of internal medicine, Ohio State University; Dr. C. I. Brown, medical director, California Division of Lockheed Aircraft Corp.; Dr. Neil Foster, medical director, Washington Corp.; Bloomington; and Dr. R. H. Fahn, director, National Institute of Mental Health; Dr. C. J. Kohn, medical director, United Air Lines; Dr. W. R. Lovelace, surgeon and director, Lovelace Foundation for Medical Education and Research; Dr. R. A. McGowan, professor of environmental health and safety, Harvard School of Public Health; Dr. L. C. McGee, attending chief of the department of medicine, Delaware Hospital, Wilmington; Dr. C. M. Stone, past president, Boeing Aircraft, Inc., now in private practice; Dr. J. B. Tübbach, medical director, Northwest Airlines and consultant in internal medicine, Mayo Clinic; Dr. R. J. Wolgar, Cleveland, ophthalmologist.

FAA Files Complaint In Airline Suspension

Washington—The Federal Aviation Agency filed a complaint with the Civil Aeronautics Board last week against reasons for the suspension suspension of Acute Pacific Airlines' operations certificate following the recent crash of an Acute Pacific C-46 at Toledo, Ohio.

In its complaint, the FAA gave those reasons to the CAB, which is currently considering an appeal by Acute Pacific to overturn the agency's suspension order.

- Aircraft exceeded its 2,000 lb. the maximum take-off weight of 46,548 lb.
- The flight took off despite information that weather conditions were below authorized minimums.
- Acute Pacific told the FAA it had discharged the pilot of the aircraft two days before the accident, pending an report of a Section 87 inspection because of previous Civil Air Regulations violations.
- The aircraft was equipped with a radio, single engine aircraft was not equipped, and had not been properly inspected or maintained.
- Acute Pacific has failed to meet reports and discrepancies noted in the company's current records and operations.

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Electra Testimony Points to Bird Ingestion

By Robert H. Cook

Washington—Probability that bird ingestion in the engines caused the crash of an Eastern Air Lines Electra on Boston Harbor was endorsed by a majority of government and industry witnesses last week before a House aviation subcommittee investigating the accident.

The bird theory got only partial support from Civil Aeronautics Board investigators, however. They ruled after two to the spring, problems of birds around airport areas, but withheld any definite statement on the probable cause of the accident pending current Board studies of the Lockheed aircraft's control surfaces and of the duties of the Electra's crew during an emergency.

FEBA Stands

At the same time, the Flight Inspection International Association, which has Boston spokesmen as FEBA testimony that failure to remove from the bird impact may have been a direct result of the pilot's attempt to cope with a mechanical emergency as dictated by Eastern's operating manual for the Electra. FEBA and that, in their present form, Eastern's manual's adequate many flight engine duties to the pilot and are therefore not in compliance with the intent of Federal Aviation Agency certification of the aircraft as Lockheed's recommended crew duties.

The charges were emphatically denied by John H. Holloman, Eastern vice president, who termed the FEBA stand part of a "continuing pandemonium dispute" between engineers and pilots. Eastern supports the bird ingestion theory as the probable crash cause.

"We are shocked that an airline union would deliberately attempt to do credit as a result, as a result, a catastrophe, and the federal regulatory agencies, all in an apparent effort to achieve some slight leverage in a new, distant dispute with another union," he said. Holloman promised that a detailed rebuttal to the FEBA charges will be available to the subcommittee.

Edward R. Quasada, FAA administrator, who first advanced the bird theory, noted the early development, testing and completion of the Electra, along with current investigations, can be conducted by Lockheed to correct structural defects which Lockheed said caused two Electra crashes.

Following his testimony that Electra airplanes and engines have been designed to withstand the impact of four pound birds during FAA-conducted tests, Quasada pointed out that the accident at Boston "presented a new as-

port of the bird problem was previously encountered." He added the ingestion of swimmers could have caused the crash, since one might be hit at the same time. "He later said he was 'sure it was a flock of birds' that caused the accident to crash."

Quasada said FAA is doing further research on the bird problem and has recommended several corrective measures to authorities at Boston's Logan Airport, some of it up to the airport operator to eliminate such hazards.

At the same time, the president of the CAB's Bureau of Safety, told the subcommittee that increasing bird test data was evidence of a "new matter" being studied by the Board, which will hold public hearings on the Electra accident on Jan. 11-12. All data compiled by CAB on this problem will be presented at the hearing, he said.

Less than a month after the Eastern crash, Quasada said, another of the airline's Electras had a non-fatal staffing accident at Logan. The crew was aware that the runway had been reported for birds and cleared clearance was given. As it was done at the time, at a speed of 150 kt., according to Quasada, the aircraft hit a "cloud" of birds and was forced to abort the takeoff. "No structural or engine damage was suffered by the transport, he said.

Also at Logan, Quasada said that on Apr. 4, an American Airlines Electra crashed, having about 100 birds in its engine, which forced No. 2 engine and returned to the field.

On Nov. 11, a Continental Airlines Boeing 707 struck a flock of seagulls after takeoff from New York's LaGuardia Field, New York, City, suffering a power loss on No. 3 engine which forced it to return to the field, Quasada said.

In another development late last week in Boston, the FAA's Douglas DC-8 scheduled flight 100 was aborted during initial roll when the transport ran into a flock of 150-200 starlings in low flight above the runway at Logan Airport. The pilot was able to abort the takeoff, and the aircraft was returned to the ramp for inspection. Bird-related investigation revealed no damage, but the flight was cancelled and the 10 passengers rechecked.

Witnesses recovered from the Boston Electra crash showed that No. 3 engine had been shut down, and its cooling had a large dent that may have been caused by a stamp, the CAB spokesman said. The "stamp" was a powerplant, showed evidence of being in normal operation at the time of impact, he said, but they could possibly have hit the engine before the crash.

Quasada said with a "no" to a witness that query whether he would say that powerplant failed because of the accident, explaining that the Board is still investigating other phases of Electra operations, including "witness study" of the aircraft's elevator boost system. A problem in that system came to light recently on an Electra flight training near Atlanta, Ga., he said.

In addition, Quasada said the matter of cockpit management and posed the question of human factors at a crew resource management session at the accident. "What happens when the windshield is suddenly plastered with birds... where do all the birds go?" he asked. He added that there is no criterion to control the Boston crash with earlier Electra crashes at Buffalo, Tex., and Tell City, Ind.

Lockheed Blames Birds

Robert E. Gross, board chairman of Lockheed Aircraft Corp., agreed that there was no evidence between the Boston crash and the B-70E Aerosonics and Northrop's Aerosonics accidents, which the manufacturer was being caused by a vibration problem now being corrected. On the basis of an "independent" testimony and evidence, including "witness" evidence of loss of power from two or more engines while in climb and a shattering and shattering that could indicate a stall condition, Gross said he personally believed the bird ingestion. "It appears that the air intake, tongue, and flap openings literally were smothered by the feathers and bodies of thousands of birds. Nothing happens in the worst accident on other possible explanations," he said.

Lockheed engineers told subcommittee chairman Rep. John Bell Williams (D-Min.) that the missing three engines on the Electra was an Electra was more than generating the equivalent of only 1,500 hp, at the takeoff power of one engine. Their estimate was based on a distance, time and altitude analysis of the accident and such a power loss may have been due to bird ingestion. While the accused powerplants appeared to have been developing normal power, the Lockheed engineers pointed out that they could have failed, then stopped, but to avoid power seconds before the crash.

Their opinion was supported by H. H. Dix of the Airlines Division of General Motors Corp., manufacturer of the Electra's Allison 50-D engines. Dix noted that powerplants which had bird ingestion could cause a power loss for 1 to 3 sec; that could amount to as much as 100% of an engine's total power.

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able bearings. Typical of the bearing refinements designed by SKF to solve the aerospace industries' most critical problems, these bearings are being manufactured right now:

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precision ball bearings for cryogenic applications.

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Achievements like these—in engineering, research and manufacturing—are constantly being brought to bear in all-out effort to reach an ultimate goal: **PREDICTABLE RELIABILITY IN AERO-**

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AIRLINE OBSERVER

► Self-contained hydraulic starting system for the Napier Eland 160 turbo-prop engine is being tested by Alghissey Airlines as one of its Eland-powered Cessna 540s. The single-function hydraulic start system was developed by the Valvoline, Inc. Division of Sperry Rand and uses a Soler T-62-T turbine APU to eliminate dependence on ground support equipment for engine starts.

► Total Trans World Airlines bank balances offset against deferred loans (AW Oct. 31, p. 77) amounted to approximately \$19 million. Total bank loans in default were \$27 million, but part of the \$27 million TWA balances offset were federal income tax accruals, and the banks subsequently were persuaded to leave these funds alone.

► Union of professional and administrative employees of the Air Line Pilots Assn., a union within a union composed of 14 full-time staff members who handle ALPA business affairs, has reached agreement only on salary labor practices complaint against the pilots' union, placed before the National Labor Relations Board earlier this month. Agreement gives the staff members increased sick leave, Blue Cross-Blue Shield insurance paid by ALPA, paid vacation. Signature of a pay raise written and machine. Contract to be signed will have an 18-month term retroactive to Nov. 17 and ALPA agrees to negotiate the pay raise 90 days later and submit the staff members' pay complaint to arbitration.

► Complaints from passengers who are denied entry into scheduled airline private clubs have prompted an informal investigation by the Civil Aeronautics Board of such private clubs as American's Admirals Club, TWA's Ambassador Club and Pan American's Clipper Club. Findings of the current investigation will determine whether Board will launch a full-scale probe of the clubs to determine whether any discrimination in handling membership or providing service is involved. All clubs operated by airlines are now under CAB review.

► Russian commercial scheduled helicopter service to the Moscow area now connects all of the city's major airports with a helicopter near the downtown area. Flad has now closed with the inauguration earlier this month of Hiplan, single rotor Mi-4 two flights between Vnukovo south of the airport to Bityuro airport on the northeastern suburbs. The new 34 mi route is the longest on the Moscow helicopter system. Flying time is 25 min. Aeroflot began regular Mi-4 flights between the heliport at Central Airport near downtown Moscow and Vnukovo and from Vnukovo to Sheremetyevo Airport, northwest of the city, on Oct. 11. Initial service of this type started last July with flights between the downtown heliport and Sheremetyevo.

► Trans World Airlines' fleet between major overhalls on its Boeing 707-351 and 707-331 turbojet transports has been increased by Federal Aviation Agency from 2,100 hr to 4,000 hr. Time between overhalls on the Pratt Whitney JT3D-7 turbojet engines which power the 707-331 has been increased 200 hr, to a total of 1,400 hr.

► State-owned Inip Airways will become an independent administration with its own board of directors attached to the Ministry of Communications on Apr. 1. Since 1958, the airline has been a department within the Directorate of Railways. Airline operations will be controlled by the board of directors which is headed by the Minister of Communications.

► Several airlines are seriously considering a major change for their Electra after they return from the Lockheed modification program at Burbank Modification are designed to eliminate high speed vibration problems responsible for two of the five fatal accidents with the transport (AW Oct. 24, p. 57). One Electra operator has a team of pilots and sales representatives discussing safety problems with equipment or travel accidents which have prohibited their employees from traveling on Electra.

SHORTLINES

► Alghissey Airlines has been denied authority by the Civil Aeronautics Board to operate nonstop service from Wheeling, W. Va., to New York. CAB and Alghissey should operate single plane, two stop service instead between any of three West Virginia airports—Wheeling, Huntington or Parkersburg—and New York via Pittsburgh and New York.

► Civil Aeronautics Board has postponed action until Jan. 1, 1965 on amendment and enforcement extension of Part 298 of the Economic Regulations, governing Air Taxi Operations due to expire Nov. 30. CAB said the rules will have to be changed to allow for the fact that Alaskan Air Taxi Operations will come under the jurisdiction of the State of Alaska Jan. 1 with respect to various regulatory functions which formerly could be exercised by the Board.

► Los Angeles Airlines has received Civil Aeronautics Board approval to offer express service between Los Angeles and Riverside and San Bernardino, Calif., using the first of its Sikorsky S-62 turboprop-driven helicopters.

► Northeast Airlines has received CAB approval to temporarily suspend service at Providence, R. I., pending Board action on the carrier's application to permanently delete the city from its schedule.

► Pan American World Airways reports it earned 6,611,460 lb of cargo weight-based and 6,212,460 lb enroute on its transatlantic routes during the first nine months of 1964, a 45% gain over the 1959 period.

► United Air Lines has opened its new air freight terminal at San Francisco International Airport, a 22,000 sq ft building leased from the City of San Francisco.

► Yang Airlines of Brazil, has begun direct Boeing 707 intercontinental service from New York to Buenos Aires via Rio de Janeiro and Sao Paulo. The new 707 service will leave New York on Tuesday and Thursday evenings and Buenos Aires on Wednesday and Friday evenings. In addition, the Brazilian carrier also is operating a weekly round trip 707 service from New York to Berlin and Rio de Janeiro, with connecting Sud Aviation Caravelle turboprop service to Sao Paulo, Porto Alegre, Montevideo, Buenos Aires and return.



PERFORMANCE ON TRIAL Bendix achieves optimal man/machine interfaces in early system design through testing on its Computer Operated Electronic Display (COED). Designed to simulate the operator's station in the EAGLE Missile System, COED also permits real-time evaluation of energy management systems, logistic control, teaching methods, process analysis, and command control. Career positions are open involving use of this advanced technique for system design.

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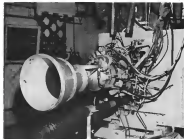




EVOLUTION of the Agena model engine is shown in test models, ending with XLR 51BA-9 in foreground at left. In early model of this engine, Bell Aerospace engineers built an extended graphite nozzle extension, which caused manufacturing, handling problems.



MODING Agena modification—the XLR 51BA-9 covered nozzle length and eliminated the liquid flow regulator. Before Bell refueled from turbine exhaust duct in older firing of XLR 51BA-7 was caused loss of test cell, noted at end of large 20-in. pipe.



Bell Adapts

By Michael Yaffee

Bell, N. Y.—Bell Aerospace Co. has just delivered the first XLR 51BA-9 rocket engine, the fourth and latest model in the Agena series, to Lockheed Aircraft Corp. The engine will probably be test flown in a Discovener satellite shortly after the first of the year.

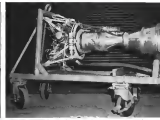
At the moment, the XLR 51BA-9 is the last Agena model for which Bell has a definite contract, it and the preceding XLR 51BA-7, third in the series, are the engines that will probably be used in most of the Lockheed Agena reconnaissance and early warning satellites and space probes. However, Bell has already submitted proposals to Lockheed for still further modifications of the engine in which a number of higher energy propellants are suggested for use in place of the present unimolecular dimethylhydrazine and red fuming nitric acid combination.

Use of higher energy storable propellants in the Agena, it is felt, would raise specific impulse at altitude from its current level just below 300 sec. to possibly 375 sec. and, Bell claims, would provide performance competitive with that of many high energy space vehicles.

Bell already has carried out static firing tests using high energy storable propellants such as nitrogen tetroxide, chlorine trifluoride and difluorine hydrazine blends. The company has also conducted several firings with fluorine using major Agena components such as the thrust chamber and turbine pump



TO OVERCOME problems caused by graphite bottoming, a circumferential diaphragm extension, covered by retracting metal bands and straps, was substituted in fuel configuration. First Agena modification, the XLR 51BA-3 is shown at right.



Hustler Rocket Engine for Varied Missions

available. These tests definitely indicate that the latest Agena engine will work with fluorine, says Bell, concluding that some modifications would have to be made in some components such as pump, seals and injector.

Originally developed to power the air-to-surface weapon pod on Convair's B-58 bomber, the Bell engine actually outlasted the preliminary flight testing stage, in May, 1957, and then passed into service when the powered weapon pod portion of the B-58 program was canceled. It was retained in the list of 1957 when Bell was awarded a contract by Lockheed for an all-shaft engine which, with minor modifications, was to be used in the Discovener program.

Major Model Changes

In the past three years, the original Bell Hustler engine has passed through four major model changes and many significant modifications. The most significant of these modifications, perhaps, has been the incorporation of a restart capability which enhances mission versatility and performance. But there have been several other important changes.

Here, briefly, is a rundown on the evolution of the Agena engine.

• **Grounding capability** was the principal additional requirement stipulated in the original Lockheed contract. By Feb. 1955, Bell had delivered the first Hustler engine (provided for launch and crew control), the XLR 51BA-1, and the flow in the Discovener 1 in February, 1959. Engine restart was redesigned



FIRST modification of XLR 51BA-3 included addition of nozzle closure and gaseous fuel.

POINTS OF DEPARTURE



ONE-STOP SHOPPING FOR THE ON-SITE TITAN COMMAND CONTROL SYSTEM A supermarket for systems—that's one way to characterize Stromberg-Carlson's systems capability. USAF officers found everything needed to develop the on-site Titan CBM Command Control System under one roof at Stromberg-Carlson.

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And there's another important fact that will get the Titan project off its pad fast. That's Stromberg-Carlson's unique brand of systems management. We call it Core Concept. We maintain a permanent staff of top scientists, engineers, technicians and management people—plus a group of prize capability subcontractor companies—in advance of systems proposals. With our complete systems once permanently pre-assembled, we're able to move ahead at full speed once a system contract is awarded.

And cost? Core Concept efficiency should reduce systems management costs significantly. If this sounds attractive, why not let one of our systems experts explain all the details to you.

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Today's computers are fast, but they can move a lot faster. Currently, S-C scientists are investigating one of the most promising ways of helping computers live up to their ultimate capabilities. Underway is an extensive study of thin magnetic or dielectric films and their application to high-speed storage systems.

At present, operation of high-speed computers is delayed by the access time to stored information of conventional magnetic core storage systems. Magnetic films have the potential of providing an access time to stored information approximately 100 times greater.

The application of solid-state devices, in conjunction with thin magnetic films, can provide an entirely solid-state storage system with such major advantages as lower cost per bit and increased storage density as well as reliable higher speed of access time.

Investigations will also be made of other promising devices such as cryotrons, tunnel diodes, and partial switching of ferrite cores. This program is only one of Stromberg-Carlson's numerous basic research projects now in progress in all areas of communications systems and advanced electronics.



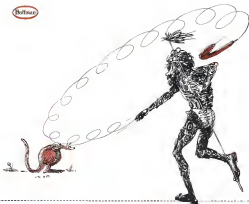
SINGLE SIGERANO TRIUMPH: 100 WATTS AND IT FITS IN A HATBOX The compact transmitter, weighing just 60 pounds, is the Stromberg-Carlson Single Sideband S-C 901A. Total volume is 3650 cubic inches. It generates 20,000 frequencies from 2 to 30 megacycles.

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There's clockwork tuning that allows an operator to pick his frequency in no time at all. Frequencies have a stability of one part in 10^7 per week. The unit is highly maneuvered. A unique hemispherical design eliminates forced-air cooling. With a peak envelope output of 100 watts, it draws less than half the power of comparable AM equipment.

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Agema Engine Program

Through their series of continuing collaborations, Bell Aerospace Co. has succeeded in fitting its Hydrex waste motor engine into the Agema vehicle and upon space payloads. Already established in the workshop of the Air Force's Discoverer satellite program, the Agema with its modified Hydrex payload sled system is also scheduled for use in the following programs:

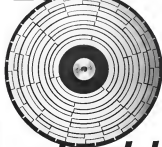
- **Major release early warning satellite.** Agema will be used atop an Atlas booster in this program.
- **Satellite optical reconnaissance satellite.** will also use an Atlas Agema combination.
- **Ranger lunar exploration project.** Present plans call for use of five Atlas Agema launch vehicles (AW Oct. 26, p. 34).
- **Shuttle weather satellite program.** currently calls for use of four Atlas Agema rockets.
- **Mariner planetary probes to Mars and Venus** will use Atlas Agema vehicle combination.
- **Orbital period of passive two-way radio emission** may be launched in Atlas Agema vehicles.
- **Orbiting astronomical observations** will be put into orbit in Atlas Agema rockets.
- **Torque Sensor satellite.** a joint U.S.-Canadian venture to explore the moon sphere is expected to use a Thor Agema launch vehicle (AW Oct. 27, p. 38).

and reduced overall engine weight now from about 270 to approximately 250 lb. Also a needle thrust was added to cause guidance at altitude in achieving atmospheric pressure of 14" in the thrust chamber.

In the spring of 1968, Lockheed awarded Bell a second contract citing for an improvement in performance within the same engine guidelines. Bell engineers substituted the hypersonic projectile combustion of supercritical oxidant hydrazine and red fuming nitric acid for the nonhypersonic IP4-KFNA system. This required redesign of the injector but provided over 100% increase in specific impulse and eliminated the need for the UDMH gasifier ring and the reaction system equipment. Further improvement in performance at altitude was obtained through a nozzle extension of approximately 10 inches, which increased the nozzle area ratio 10%.

Bell engineers at this time took the opportunity to simplify the propellant flow control system by replacing the liquid flow regulator with a constant velocity. Principal results at all these changes were a 10% increase in specific impulse and a moderate increase in thrust which translated into a 10% increase in payload capability. The first

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of these new XLR SIRA-5 engines was delivered in the fall of 1958 and flew in the Discoverer II satellite in April, 1959.

• Third contract from Lockheed, awarded in the late spring of 1959, called for dual start capability and a 100% increase in burning time. Bell engineers added a second solid propellant starting charge and altered the starting sequence to provide an oxidant load which would take the place of the earlier oxidant charge in providing the initial combustion chamber pressure required for starting. At the time, Bell engineers also developed a fuel shut-down system.

• Requirement for a 100% increase in burning control a serious cooling problem for Bell's aluminum-cased engine. To overcome this, Bell engineers varied the geometry of the cooling channels drilled longitudinally in the engine walls. The fear of these XLR SIRA-7 engines was that in Discoverer XVI on Oct. 26 (AW Nov. 7, p. 27).

• Under the most recent contract from Lockheed, awarded last fall, Bell engineers increased work area size by more than 100% with an etched titanium nozzle extension and designed a more efficient engine. As a result, the fourth modification of the original Bell Booster, the XLR SIRA-9, achieves a further increase in specific impulse at altitude of approximately 7%. Thrust has also been increased in that with the first thrust increase obtained in the dash 5 model, overall thrust of the Agena has risen approximately 1,000 lb.

• In the RA-9 engine, Bell also added gage windows to the tank system for level measurements and redesigned the injector for greater efficiency. These gage windows, used before on the shut-in line with the main pump, are controlled in pressure pumps and have allowed by 10% the amount of gas variation needed in the propellant tanks. The first XLR SIRA-9 was put recently delivered to Lockheed and has not yet flown.

Structural Details

As it now stands, the XLR SIRA-9 Agena engine, not including propellant or tankage, weighs about 250 lb., is 15 in. in diameter (measured across the mounting points) and is approximately 7 ft long. The thrust chamber is fabricated mostly of aluminum except for a newly added titanium nozzle extension which is uncooled and cooled on the inside with helium. Straps and hoops fashioned from a titanium metal are used on the outside of the nozzle for greater structural integrity. The combustion chamber and nozzle portion of the nozzle are approximately cooled by conduct.

The engine operates at combustion

To increase safety at all altitudes...

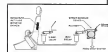


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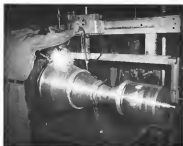
CREATIVE INNOVATION AND DEVELOPMENT OF AIRCRAFT DEVICES



Air Force's T-39 Sabreliner exceeds design specifications

The T-39 Sabreliner, Air Force's first non-jet utility trainer, bettered its design speed and range by handsome margins in a non-stop test flight over the Western United States. Designed to cruise at 500 mph over a range of 1720 miles, the competing T-39 averaged 540 mph during an 1820-mile flight. Then it loitered for an additional half hour and landed with ample fuel reserves.

The Air Force has ordered 94 of the multi-purpose aircraft for use as radar, navigation, and jet-proficiency trainers—as well as high-priority cargo transports. The T-39 is an aircraft of exceptional all-round utility and economy—a compact workhorse designed especially for jet-age needs. It is being produced by the Los Angeles Division of North American Aviation.



Bell welder checks automatic welding equipment used to attach nozzle to Agnos rocket motor. Nozzle's nozzle necks ending chamber drilled in Agnos first chamber wall

chamber pressure of approximately 500 psi and produce a thrust of 16,000 lb.

Specific impulse at altitude is believed to be between 290 and 300 sec. Propellant tankage reportedly will accommodate about 13,100 lb of propellant.

Agnos Production

Of the four Agnos models (Bell designation is chronological order of development, 5051, 5052, 5053 and 5054), it is believed that only the last two are now in production. Except for the Discoverer satellite program shell, which is expected to use the remaining XLR 51RA-5 engines as well as the dash 7 and dash 9 models, most of the other Agnos-based vehicles will probably use either the 7 or 9 model with the 9 generally being used for the heavier payloads.

Basically this is how the latest Agnos engine operates. When the programmer closes the "fire" switch, electrical energy fires a 25-ohm resistor, detonates a squib which opens the solid propellant gas generator and at the same time activates the propellant pilot valve, causing it to drop. Gas from the burning solid propellant starts the turbo-pump.

Closing of the propellant pilot valve in effect redirects flow to the gas generator valve. When the squibbing gas is provided by the turbo-pump from sufficient, it forces the gas generator valve open, and turbo-pump operation, now fed by the engine's regular liquid propellant, becomes self-sustaining.

Exhaust pressure from the engine

pump forces open a spring-loaded propellant valve that controls the flow of oxidizer to the thrust chamber. When the oxidizer flow is established at 5000 or rated flow by an oxidizer manifold pressure switch, the switch is closed completing an electrical circuit through which a fuel pilot valve is energized. The fuel pilot valve then allows gas, to build up in the fuel valve side strong cylinder which forces the fuel valve open, permitting fuel to flow into the thrust chamber. The purpose of this arrangement is to provide an oxidizer leak to the combustion chamber. This initial oxidizer flow vaporizes, building up pressure in the combustion chamber which "tools" the cupine into flexing it to a lower altitude where it can start.

Restart Capability

For restart capability, the engine is provided with a second starting coil. When a second solid propellant gas generator and an oxidizer valve first shut down occur. When the restart squibbing is developed, Bell engineers found that the lag or hysteresis in the closing of the spring-loaded oxidizer check valve resulted in a heavy after flow and loss of oxidizer. So Bell engineers developed a fast shut down system in which solid nitrogen, again under force of shutdown, is fed to the back side of the oxidizer check valve to force it shut. A small hole in the valve fitting permits the nitrogen pressure to dissipate to the outside after three to five seconds, at which time the check valve can be reopened for the restart operation. ♦♦



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The false alarms which have continuously plagued anti-submarine warfare operations will be eliminated by a new sonobay under development by Chance Vought Electronics Division under the sponsorship of the Navy's Bureau of Weapons. This unique electronic device is being tested now against Navy surface ships and submarines at Key West, Florida.

Vought sees this sonobay as part of a family of new ASW systems which would converge from the sea, air and space to pin down enemy subs. Other links in this three-dimensional defense are also taking form at Chance Vought, where the combined resources of all divisions provide the broad capability required.

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Early Space Test of Ion Rocket Urged

By Russell Hawley

Monsters, Cold—Rejuvenant for an early flight test of an ion rocket was expressed at the American Rocket Society's Thirteenth Propulsion Conference held at the U. S. Naval Postgraduate School here, as speakers who estimated that a small battery-powered motor could be delivered for flight test within a year or a year and a half.

In fact, no firm date has been set for such a test, but speakers most frequently heard during the conference put it in 1965 at the earliest (AW Oct. 31), pp. 25, 70).

SNAP-7's nuclear power system for electric propulsion is supposed to begin testing in 1965. Many of the problems and questions at the conference suggested that methods of calculating the expected change of the exhaust should be proven before that date. Most scientists working on electric propulsion apparently are convinced that little more can be done to earth-based laboratories to prove the work of checking methods of calculating the electrical change of the ion rocket exhaust. Despite careful efforts to eliminate the effect of walls and instrumentation, it is not certain that anyone has successfully duplicated the conditions of low speed, low temperature plasmas should fall and the overall exhaust should hold a positive space charge behind the throat chamber even the motor probably would still within a few microseconds.

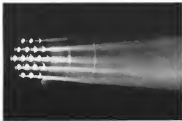
Space-Test Studies

David G. Elliott of California Institute of Technology Jet Propulsion Laboratory presented a study of trajectories and techniques for specifying ion rockets. Elliott described a proposed ion rocket test vehicle to be launched by a Navy Scout four-stage solid-propellant research rocket which is relatively inexpensive and immediately available. He said the necessary tests could be made either in high-altitude probes or orbital trajectories. Orbital tests offer the advantage of longer duration but a high-altitude probe would keep the test within telemetry range at all times. Scout could launch a 10 mib (millipound) thrust ion motor with its power supply and telemetry system into a probe trajectory giving a test duration of about 1.4 hr. Battery life limits orbital test duration to a maximum of a few days. Longer duration must await solar or nuclear power developments and are unnecessary in earth tests.

Elliott's proposals on ion tests were well liked by such ion motor operators. He said the first space tests should be



PROTOTYPIC ion motor developed by Electro-Optical Systems, Inc., perfects small hand-held apparatus of thrust during test below; also simulated space conditions. From a pulsed beam motor operation source and projected by 150-lb electrodes.



AUG. 19,
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Novel Measuring Device

Ultra-low pressure measuring device, developed by Westinghouse Electric, now ultra-violet beam focused on solid surface to produce electrons that subsequently produce ion current of focus and heated filament, measuring probability of ionization time of gas being measured. The device, known as a photoelectron ion gauge, is portable in less than one step of 10" to 10" ion current, equivalent to pressure of at least one at altitude of 50 to 600 mi.

of motion with thrust levels in the range between 1 milb and 10 milb thrust. At least below 1 milb, the size of beam diameter to accelerate electron, imply the motor can be small enough to yield thrust even without space charge neutralization making much useful for larger, more practical ion propulsion units. The 10 milb upper limit is set by the fact that no larger motor of the present common contact ionization type are now under development.

For thrusts and test duration can be replaced. Effort indicates that other ion engine batteries in suspension or station also can will be the highest power source. The key value to be measured is thrust. If neutralization field space charge accumulation will quickly bring thrust to zero, some accurate better. Effort indicated less certain. He considered circumstances in which the net thrust would be the vertical sum of the electrostatic force between the electron vehicle and jet reverse thrust of the ion motor.

Effort suggested four ways of measuring thrust of the open jet ion motor. • Measurement of changing orbit curves from a spin stabilized satellite test vehicle with the ion motor delivering a well-defined acceleration, keeping the vehicle closer to earth on one side of its orbit and farther from earth on the opposite side. No guidance system would have to be carried.

• Measurement of changing orbit by use of an attitude controlled satellite test vehicle with its ion motor devices

Two tin cans, a length of test string and two kids... many windows

"bits" of information have been communicated by this process. As a matter of fact, the signals were often times so conditioned that no adult discriminator

related that could decode them. Through experience such as this (even quite a bit of us exhibited a more technical interest), Georgia has developed a number of telemetry components... from the ground up (or vice versa, as the case may be).

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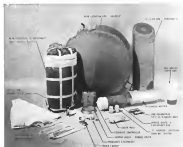
Flight-line checkout by DATS (Dynamic Accuracy Test System) tells the interceptor commander whether his aircraft and weapon control systems are completely ready for a successful mission. As a result of field evaluation tests, showing the effectiveness of DATS in improving weapon control performance, RCA has been awarded an Air Force production contract. Developed by RCA's Airborne Systems Division, Defense Electronic Products, Camden, New Jersey, DATS is a new approach to the evaluation of system readiness.

It makes certain that only aircraft with properly operating weapon control systems are sent on missions. Based on a building-block design employing the highest reliability factors, a mechanical programming device and self-test capability, DATS utilizes a series of synthesized attack runs typical of mission conditions. DATS could be made applicable to many interceptor types of aircraft.



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Landing System Designed for Mercury

Project Mercury landing system components were designed and packaged by Northrop's Aerospace Division (AW Oct. 26, p. 65). Subcontracting has been completed with a 4 1/2 lb. cable that between the capsule and the base shroud, which separates from the capsule before landing. This is confined between capsule, shield and perforated duct serves as a pressure cushion to minimize landing shock. It also will serve as a air motor for a capsule floating after a sea landing.

ing third along base tangent to the unit.

• Measurement of motion relative to a reference object separated from the vehicle, but not necessarily outside of it. The motion of a ball released within a chamber of suitable air could easily be observed by photo-eye. Usable after motion could be generated from a short duration thrust pulse. A thrust room experiment could be obtained in a constant air flow.

• Measurement of external acceleration produced by measuring the trajectory of a known distance, to one side of the vehicle, center of area with the thrust line intersected in an open space. Rotational acceleration would then be a measure of one thrust and could be increased accurately as a function of thrust and could be directed to the ground. During a 1440 ft. drop, a 1/2 ft. could cause a spin rate change of 235 rpm. If the motor produced the expected 18 in/s thrust, the 1/2 ft. could cause a spin rate change of 180 rpm, the test motor could be used to rotate that rate to 1/2 rpm and then spin the vehicle up to 75 rpm in the opposite direction. Spin rate can be sensed by an accelerometer (which is not yet made) the vehicle (that) leaves the test jet.

(Frank R. Kaufman of National Aeronautics and Space Administration)

LONG BEACH, CALIF. (UPI) — AVIATION Week staff scientists working in the field of electrostatic propulsion are giving less much attention to conventional contact ionization. He said that between 80 and 90% of the information working in the field have adapted this means of generating ions. Contact ionization is relatively easy, generating but Kaufman argues that it is too early in the development of the technology for so much of industry to abandon the search for better ways of creating the ion beam.

Kaufman and Paul D. Rensler, also of Long Beach, reported on their own work using electron beam ionization. This, they claim, offers the mechanical simplicity, reliability and efficiency of the two ion guns they have made upon this principle give them much promise in space propulsion. One mercury ion beam was used as a propellant in the Long Beach Research Center experiments but Kaufman and Rensler report that other materials could be used.

Kaufman said that in experimental runs their motor has achieved 87% power efficiency (ratio of beam power to input power), 90% efficiency, at a specific impulse of 5,000 sec. corresponding to 11 in/s thrust. The experiments about 77% higher power efficiency than is claimed for an electron contact ion motor.

The specific impulse is right in the



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Known as an AirResearch requirement for cubic temperature of a jet engine, it is similar to 25 mm air element inputs and supplies command signals to 16 amplifier channels. Consisting of surge-sensitized pneumatic mode, one switch programmer and other electromechanical components, it is another example of AirResearch's own all-activity in design and production intricate and complicated series systems.

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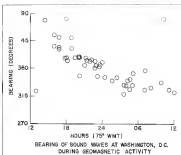
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Infrasonic Wave Measurement

Low frequency sound waves produced by geophysical forces, measured by National Bureau of Standards as part of their infrasonic wave measurement program, undergo a shift in seismic direction with the changing from northeast to southwest between midtime and becoming southerly at midnight. The geophysical seismic waves have a period greater than 20 sec. and travel across the surface of the earth at speed greater than velocity of sound sometimes three times as great. Infrasonic waves also are produced by earthquakes and missiles but have different characteristics.



NBS infrasonic detection system in Washington consists of four microphones, each fixed to solid concrete slabs above, supported by cement walls, whose output signals are fed to a central recording center. Non-infrared paper beam sensitive effect of local turbulent wind currents. Direction of approach of infrasonic wave and its velocity are determined by comparing instant of detection at each microphone. NBS plans to make mobile infrasonic wave detection installation at Boulder, Colo.

Facility Inadequacy Hurts Re-entry Design

Washington—Lack of adequate facilities, both a hindering design of launch and planetary re-entry vehicles according to Dr. Frederick R. Riddell of Aero Corp.

"First rate" design data, Riddell said, cannot be obtained because existing facilities do not provide adequate air oxygen at high velocities to simulate heat transfer, structural and stability problems at extremely high velocities.

Riddell, technical assistant to the president of Aero Research and Advanced Development Division, and a facility is needed to duplicate velocities of 10,000-36,000 ft/sec. The highest currently available is 24,000 ft/sec.

These, however, design jobs require higher velocities in test jets in order to study heat transfer, an inherent danger, for study of stability and flow area, from the body and in shock tubes, for free physical studies, he said.

Riddell discussed characteristics of these flow facilities, bodies to illustrate the varying vehicle design requirements, having comparisons on structures with one-hot-test mode.

AICM, with a re-entry angle of 10 deg. at 24,000 ft/sec. Demonstrating heat transfer data is correct, although relative effects are present. Maximum structural load is 10.

• Earth orbit, is a shallow (two-degree) re-entry at 36,000 ft/sec. In this situation, heat pulse is of a long duration, but of small value compared with the AICM. Peak load also is smaller—about 10. Heat transfer is direct entry from convective.

• Min-Venus vehicle, re-entering at a steep, near vertical angle at 45,000 ft/sec. Velocity. Peak loads and heating are seen there in duration, but of course comparable with the AICM and with the bodies with solution the dominant method of heat transfer at the stagnation or behind point. Peak load of 10 is longer for several seconds in steep angle re-entry.

• Mars-Venus land design re-entry, also at 45,000 ft/sec. Shallow re-entry of entry radius peak load and heat transfer but there is longer duration. Peak of 10 is expected, with heat transfer from convective.

Aerojet Studies Guide Mach 5 Vehicle Design

Aerojet General's Spacejet Division, Azusa, Calif., is conducting extensive studies in established techniques for guiding engineers in the design of reentry aerospace vehicles flying at Mach 5 plus. The 35 month, \$1 million

research program is sponsored by ARDC's Wright Air Development Division.

Several 4-ft wing span static and flutter models will be tested in the wind tunnels at Aerojet Engineering Development Center, Azusa, Calif., and subjected to simulated speeds from Mach 5 to Mach 8 at altitudes from sea level to 300 mi. The models, having a 70 deg. single swept wing, will provide basic measurements in the subsonic speed and altitude range. Some models will be subjected to heat treated steel while flutter models will be made from a sandwich of plastic foam and aluminum sheet.

Explorer VIII Relays Ionospheric Data

Washington—Explorer VIII does ionospheric measurements at altitude in providing approximately 12 sets of data on each pass in an orbit which has elements very similar to those at equinox.

Scientists were planning the first observation to the electric field in the ionosphere at altitudes of 100 to 200 miles. The data will be used to study the ionosphere's structure and its effects on radio waves. The data will be transmitted for analysis two months (JAN. 7)

g. 10). Power lifetime is estimated at 2-3 years.

Field units will be commanded to take measurements periodically, because the large power drain prohibits continuous operation.

When Explorer VIII was injected into orbit it had an apogee of 3,425 mi., perigee of 248 mi. and 112.75 min. period. After one week of flight, apogee was 3,423.4 mi. and perigee was 257.7 mi. with the same orbital period.

GE Re-entry Study Has ICBM Application

Washington—General Electric, Nashua, and Space Vehicle Division has begun a study for the Army on physical phenomena in re-entry for application to anti-ICBM system.

The study, costing about \$100,000, calls for all government agencies doing re-entry physics studies to turn data to GE for evaluation. The object is to improve existing technical understanding of re-entry characteristics so parameters can be established on the probable missions of re-entry vehicles.

GE will study such long range data as theoretical ionosphere, electron density, electron re-entry physics, ionospheric physics, shock waves, gas, plasma physics and other and related optical phenomena.

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Convair 540 Conversion with Napier Jet-Prop Engines



Convair 540s undergoing modification with Napier Jet-Prop engines at AirResearch Aviation Service, the most experienced company in the modification of pressurized aircraft.

AirResearch Aviation Service converts Convair 340s and 440s into high performance airplanes and executive aircrafts with Napier Jet-Prop engines specifically designed for the Convair 540.

With over 10,000 hours of flight and a payload (range capacity of 80 passengers for 800 miles or 10 executive transcontinental trips), the Napier Jet-Prop 540 provides a smooth ride at greatly reduced noise levels and improves economy of operation in air or business transport.

An AirResearch auxiliary gas turbine installation (optional equipment) makes the Convair 540 self-sufficient on any landing strip. This on-board unit provides complete engine starting and all ground air conditioning and preflight check-out.

Installation of the 2600 r.p.m. Napier "Eland 504" Jet-Prop engines with four-bladed propellers includes

structural modifications to engine mounts, new instrumentation, and electrical and audio system modifications to maintain down time.

Conversion of Convair 340s and 440s to Napier-powered Jet-Prop 540s is performed exclusively at AirResearch Aviation Service, the most experienced company in the modification of Convair 340s, 360s and 440s into executive aircraft and luxury airliners.

Employing more than 600 of the most highly trained and experienced engineers, technicians and craftsmen in the industry, AirResearch performs all design, engineering, fabrication and installation work in one location to meet the conversion, modification, maintenance and overhaul requirements of any aircraft.

Write, wire or telephone today for complete information regarding your Convair 540 conversion with Napier Jet-Prop engines.

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AVIONICS Increasing Conventions Come Under Fire

By Philip J. Kline

Washington-Midwestern members of technical conventions, particularly in the electronics field, are having increasing uneasiness to take a critical look at the costs of engineering man hours and travel funds.

The uneasiness has reached the point today when an engineer could spend more than half the total working days in a year just attending out-of-state speakers or participating in the lunatic of Radio Engineers and its many affiliated professional groups. Add finally there are conventions sponsored by other technical societies which are of interest to electronics engineers.

Conventions Grow

In the past five years, the number of technical conventions has nearly tripled and currently, at a multiplying at an even faster rate. For example, the calendar of coming conventions in the October, 1970, IRE proceedings listed 15 meet-ups for the next seven months, while the October 1969 proceedings listed 50 conventions for the same period.

A list of 31 IRE sponsored and sponsored conventions issued in the fall of 1970 showed 11 conventions scheduled for the subsequent year, while a similar schedule just released by IRE shows 54 conventions for the subsequent 12-month period.

Criticism Increases

Engineers and scientists are increasingly outspoken in their criticism of the present situation. They complain of the general overabundance of technical papers. They attribute this in large part to the fact that manufacturing number of conventions have created a demand for papers which far exceeds the supply of significant work, in their opinion. This results in papers which largely depict

old, previous papers and/or contribute little to the audience's fund of new knowledge.

One engineer summed up his feelings this way: "If I had to pay half of my own time expenses myself, I'd stop 90% of the conventions I now attend."

Currently, engineers like the prospect of conventions which deal with a single specialized subject, such as electronic propulsion, magnetic computation or semiconductor trends. They realize that to attend such these meetings which deal with subjects of value to their work.

The non-theoretical type conventions which present a handful of papers on even subject from high fidelity to space vehicle guidance are having fewer sponsors and sponsors are becoming increasingly hesitant to support and sponsors are questioning the value of traveling hundreds of miles and spending time, or four days in the process, just to get to the field, only to find out that the speaker's presentation is not new.

Another criticism is the scheduling of papers at times the least convenient for attendees. Two often occurs during week-end periods, especially on the fall of one or more days, or they overlap with long intervals in which there are no sessions of interest to engineers specializing in a particular field.

There is growing criticism of the mail schedule among technical societies and among individual professional groups within the IRE to make out claim to new technological progress by staging a non-technical conference.

A good example is the field of communications satellites. Within a 40 day period, three different IRE professional groups sponsored four separate technical conferences, all on the East Coast, which featured new or near technical sessions on communications satellites.

Aug. 2-3: Global Communications Symposium, Washington, sponsored by IRE Professional Group on Communications Systems (PGCS).

Sept. 19-21: National Symposium on Space Electronics & Telecommunications, Washington, sponsored by IRE Professional Group on Space Electronics & Telecommunications (PGSET).

Oct. 5-8: National Communications Symposium, Union, N. Y., sponsored by IRE Professional Group on Communications Systems (PGCS).

Oct. 24-26: East Coast Conference on Astronautical and Navigational Elec-

tronics, Baltimore, sponsored by IRE Professional Group on Astronautical and Navigational Electronics (PGANE).

Several more days when the IRE decided to present sessions of Professional Groups, such as a structure with most sessions within the IRE which deals with a specialized area of electronic technology, the time of day is less than ideal, and the sessions are often delayed. There is a sharp reality and overlap.

Examples of Savings

When the Professional Group on Astronautical and Navigational Electronics was able to effectively rule out claim to space and change its year to reflect the times, the Professional Group on Electronics and Research Council decided to move to Space Electronics and Telecommunications, promising to make its own responsibility within the aerospace field.

But the main is not limited to their own groups. Because engineers and scientists have grown in number, the IRE Professional Group on AVIONICS (PGMIL) concluded that it should not be closed a side in space. The association began dealing with space technology at PGMIL's recent convention in Washington (June 17-20) where its status was to move into space.

There is growing criticism of the mail schedule among technical societies and among individual professional groups within the IRE to make out claim to new technological progress by staging a non-technical conference.

Weston Survey

Survey of 400 persons who attended the 1968 Western Electronic Show and Convention (Westcon) indicates that 60% of all attendees were new to the show and 40% were returning. The survey also indicated that 60% of the attendees were new to the show and 40% were returning. The survey also indicated that 60% of the attendees were new to the show and 40% were returning.

Survey was conducted by Data Concepts, a market research firm in Westport, management. The latter has sponsored such conventions intended to support the members of the survey firm in its studies.

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cut in space. PGCS's recent on-orbit operations indicate that it is not needed to leave the subject to PGANIL, PASET and PCML.

Recognizing the importance, complexity, human factors, instrumentation and scheduling in important elements of space vehicle design, some observers believe it may not be a question of time, but of the IRI. Professional Group on Aerospace and Propagation (PGAP), Electronic Computer (PGEC), Human Factors in Electronics (PGHFE), Instrumentation (PGI), and Reliability & Quality Control (PGRC) officials recognize the challenges of space, and of other IRI professions of groups.

Reach for Space

When the IRI Professional Group on Space Electronics & Telecommunications met on June 14, the Professional Group on Instrumentation and Navigation Electronics considered it to be a consensus of all seven groups of effort. PGANE stepped up its own campaign in space and telecomm. At the PGANE convention in Dayton, Ohio, June 2-4, more than half of the technical sessions were devoted largely to on-orbit in-space technology, ranging from electronic propulsion to interplanetary communication. There even was one session on telecomm to itself. Three weeks later, for instance, sessions including the IRI, sponsored the National Telecommunications Conference in Santa Monica, devoted entirely to the subject of telecomm.

Four months later, IRI's Professional Group on Space Electronics & Telecommunications held its own annual convention. Only one of the 19 technical sessions was devoted to telecomm, the group's original area of interest with the IRI, covering such diverse subjects as electronic propulsion and space vehicle navigation.

Space navigation might appear to fall in the domain of the Professional Group on Instrumentation and Navigation Electronics, but PASET thinks otherwise, and recently held its own bi-annual symposium in Columbus, Ohio, devoted exclusively to space navigation.

The American Rocket Society is not setting aside its whole IRI attention into the field of telecomm, though. The ARS held a Professional Symposium in Houston, Calif., devoted exclusively to electronic propulsion (see p. 67).

The ARS also is conducting talks on the IRI, and other technical societies, but a dominant role in telecomm, however, is being played by the IRI. At its recent biennial conference in Santa Monica, Calif., Sept. 27-30, devoted to space power and energy conversion.

Even the Society of Automotive Engineers (SAE) sees an important role for itself in these fields. At its recent Automatic Meeting in Los Angeles, there were technical sessions on small area power systems for space vehicles, plasma propulsion, space communication and guidance.

The American Institute of Electrical Engineers (AIEE), which has special and largely in electric power generation and control, also sees the energy, and various field as an electric problem in its area of interest. The AIEE and IRI's Professional Group on Electronic Devices (PGED), an encompassing a comparison on energy.

Even the Society of Instrument Engineers (SIE) which is concerned with power tubes and associated devices, has its role in a role as energy conversion and space power in the field of electronic devices, energy power tube properties and sales with an semiconductor devices.

In January 5 Symposium on 3rd International Energy Conversion, the IRI's Professional Group on Electronic Devices (PGED) which is concerned with power tubes and associated devices, has its role in a role as energy conversion and space power in the field of electronic devices, energy power tube properties and sales with an semiconductor devices.

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One of the most common types of pumps are of high efficiency and are therefore are frequently specified for this service. A high efficiency pump is one which is able to pump a given volume of liquid with a minimum of energy input. The pump is able to pump a given volume of liquid with a minimum of energy input. The pump is able to pump a given volume of liquid with a minimum of energy input.

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If the present trend continues, one observer notes the long-range outlook is that "the time is coming when most of the nation's engineers and scientists will be devoting practically all of their time either to writing papers for technical conferences or listening to papers at technical conferences. This will result in an ever more acute shortage of engineers and scientists, causing an astronomical rise in salaries. It may be a good thing for engineers and scientists but it could be disastrous for the nation."

One scientist sums up the situation as another war. "In most scientific effort, we place great emphasis on quality, not on quantity. The notable exception is our technical conferences which we appear to judge on the basis of the quantity of papers presented rather than on their quality."

Greater Selectivity Urged

What is sought, this scientist believes, is the greater selectivity in the choice of subjects and papers, with the present goal of quality instead of quantity. This is true, he says, that conferences need to have selective in choosing their participants, to choose authors and papers for their own sake. The latter should be both technically qualified and willing to spend the necessary time to master their material selected for presentation. It is a patient and slow.

Only in this way, this scientist concludes, can we make our technical communities representative of the best of U. S. science and technology, at least of applying technology. ♦♦



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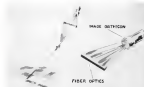
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HIGH-RESOLUTION fiber optics used TV system (left) could scan single line along with image of scene (last two views) shape introduced lateral up against fiber optic (top) of camera tube. Typical shape introduced in radio-to-line converter (upper right) and camera line converter (lower right). Drawings represent developments of RCA Defense Electronics Products.



Fiber Optics Reconnaissance Explored

By Barry Miller

Los Angeles, Calif.—Potentially high resolution, infrared and visible room passage system can glean much more from earth work now being conducted in a radical electro-optical technology based on fiber optics at AVCON/70's. A series of groups active in the field indicate.

The technology working with fiber optics—the transfer of transmitted light from one end of a narrow glass or quartz fiber to the other—can be used to specialize short line systems in applications in various space technology may be or when practical fiber optics systems may be built. With a few exceptions, work in this field centers on the research and development level.

A number of companies prominent in aerial reconnaissance have been studying fiber optics for several years. After three years' research, Radio Corp. of America's Defense Electronics Product Division in cooperation with the American Optical Co. has begun building a model of a fiber optics reconnaissance system (AW June 27, p. 77) which now demonstrates a factor of 10 improvement over comparable reconnaissance systems.

General Atomics Industries also has three years of studies in fiber optics, mainly in collaboration with Avcon Research Foundation. GAI expects fiber optics to play a role in image transmission systems, direct photographing from orbit or in the form of image transfer and in increasing resolution of field cameras in reconnaissance systems. Fairchild Camera and Instrument Corp. through the previous and continuing work of its research, acquired Allica B. De Mart Electronics Division also is active in this area.

A fiber optics system will be included by Fairchild in its proposal to the National Aeronautics and Space Administration for Propulsion Laboratory for a high-resolution photographic system to be employed in acquiring the moon's surface. Lockheed, RCA Astro Electronics Products and Eastman Kodak presently hold parallel positions contracts to study laser imaging without order for Propulsion Laboratory's VOIS (Visual Observation Instrumentation) program (AW Oct. 17, p. 27). When these feasibility studies are completed and if funds are made available, a comparison will be held among the three to determine which system will be employed in an Avcon Center-based laser system.

Application Evaluation

Applications of fiber optics in aerial reconnaissance systems is being evaluated at the Army Signal Research and Development Laboratories at Ft. Monmouth, N. J. Signal Corps reconnaissance research and at the Army's Electronic Warfare Group at Ft. Huachuca, Ariz. Under Signal Corps con-

tract Avcon Research Foundation is examining the use of fiber optics in the collection of data from side looking radar and the coding and transmission of photographic data from aircraft. For "Single Air Development" Division, Avcon is investigating infrared transmitting fibers which could improve IR guidance detection and vision.

Other major optical organizations known to be working with fiber optics, either as electro-optical applications or as suppliers of the raw glass fibers required, include Bausch & Lomb Inc., Madison, Wis., and Spaulding Electronics Corp. In addition, contractors at Bell Telephone Laboratories are developing the use of fiber optics for focusing into small areas in part of a investigation of nonconventional high-speed photography.

Bell's recent success with optical Masers (AW Oct. 24, p. 75) could extend its interest into possible non-grade properties of fiber optics.

Although interest in a myriad of potential applications for fiber optics is widespread, by the end of the decade the use of the glass fibers the underlying principles of fiber optics are not new. A number of scientists over the years suggested the possibility of transmitting images through a bundle of flexible fibers.

Light emerging on the end of a transparent rod can reflect back, be piped through to the opposite end by a series of total internal reflections. As the diameter of the rod is reduced, the number of reflections within a given length increases, but the effect remains. Light enters and emerges from the end at the same angle. If a large number of such flexible rods then have disjunct ends as the only of scattered are launched together, their ends co-



LIGHT focused on broad ends of glass fibers is projected, several times and emitted from narrowed ends.

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BGA scope transducer's thousands of parallel glass fibers taper from 13-in. length (top) to 30 parallel bases of 1 in. length (bottom).

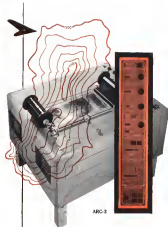


wiret or hand, and substituted for the rod, the fiber still remains. A complete image can be transferred by the glass from one point to another with such flux carrying a two percent of the image.

As long as the outer of the fiber ends at the emerging end is the same as at the entering end, the outer portions of the fiber inside can hang loose, be twisted or bent without disturbing the output image. This makes "wiring around the corner" possible and has stored much colorful young medical instrument researchers because fiber optic endoscopes, periscopes and similar devices for probing human cells now appear possible and practical.

Should they enter be assembled at one end of a bundle of many fibers, the emerging image could be unrecognizable. Scrambled images could be photographed and assembled by viewing from the output or input end, at the same as an identically scrambled bundle. Thus, coding and decoding are possible. A form of this is set, printed by RCA for negative reduction. Magnification in endoscopic imaging fiber detectors, spot and horizontal scanning are other fiber optic possibilities.

Smaller detectable detail through an individual fiber is routinely reported as 14 to 2 times the fiber's diameter because light incident on only a part of the fiber will emerge from the total diameter. On the base of the fiber figure, resolving power of a fiber bundle



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with one end diameter three would be about 500 photographic lines per inch according to Lee J. Kroski of RCA. Focusing angle for trapping light is defined as a fiber end, in the air where one is in the square root of the difference between the squares of the indices of refraction of the fiber and the jacket materials where surround and protect individual fiber. This focusing angle is referenced to the center line of the fiber.

Excess System

BCA is in the model of making an actual mononitrogen system where constituents filter up to the roots and then are taken up by the plant. It would enable the system to make a wide range of size lateral to the, which root and would contain many channels of scale from across the field of view, according to Kubit.

Such a system, Krulik believes, would offer the advantages of TV compared with photo communications: namely, the inherently high sensitivity of image cathodes and the absence of the need for film (developing and some neg. for generation of a transmittable video signal). It would offer an alternative to the choice between a TV system providing the ability to see real objects in the ground (but with a very field of view) and the much larger TV systems with poor ground resolution.

Key to this system Kozak explains is a fiber optics shape transformer, or converter, which enables the system to realize a single long scanning line, by assembly from many TV line scans. Such a transformer can be made by separating the edges of a single bundle of fiber optics into a subbundle of narrow parallel edges. For example, a fiber optics bundle composed of 16 rows of fibers, on one end of the bundle might be merged into a single long line at the opposite end to allow a nonredundant, photosynthetic

If a current tube is vitiated so that it will not seal the 10 lines sequentially, a technician, from the one line from one end to the other, Keldik says. Then for 100 elements of isolation, even

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each of the 10 scanning lines the image tube contains a resolution of 3,500 discrete picture elements that provide a refreshing TV camera tube, he adds. Up to 30,000 resolution elements appear capable of being assembled into a single line. This would be the highest resolution TV input presently known, Kallak says. Although it is a single scanning line, scanning in the direction listed in the scanning line is achieved by actual video raster or by object motion should this be employed in the future.

Optical Contact

To aim the multiple rows of fiber optics the photomatrix output of the camera tube must establish an optical contact with the fiber optics. This is achieved by using circular data made of fiber optics into the front of the image cathode. In operation, the image transmitter would be turned up against the fiber optics faceplate of the camera tube. Use of TV camera tubes adds high sensitivity and high signal-to-noise ratios inherent in the storage of these tubes to a high-resolution image line and fiber optics device. This also makes possible acquisition of intelligence at low light levels.

At the output of ground and a recording system must be capable of reproducing the high resolution input. In the recording corner the video information transmitted from the camera system is displayed as a multiple line image on a conventional kymograph. These same lines are transferred using a fiber optics transducer converter into a single high resolution line which reconstructs the input photograph image by such techniques as contact printing to photographic film. The kymograph would contain a fiber optics imager, as does the cathode in the camera system, so that the kymograph imager optical contact with the fiber optics line is to be maintained.

To date RCA has made the two-tube converter the camera tube is being developed and the recording electronic equipment for the system is being built.

Fiber bundles are made, typically, in extrusion of the glass from the molten material. A single fiber can be pulled onto a large spool, under tension to a good standard. A section is then cut from this large coil and is made bound to form the bundle.

Optics Goal

Fiber optics like any other technology, especially as with cost, has its problems. Obtaining and drawing fine quality fibers which have good transmission qualities is a continuously pursued goal. Properly using fibers in its bundles and then aligning fiber optics connectors

with centers at outside end tubes are among the thorny problems, especially in situations working in the field. Preventing light from creeping from one fiber to another and then contributing to a blurred image at the output is, some scientists insist, only partially solved by the present pattern of seeking fibers with low index of refraction glass.

Nature of some of the other acts that fiber optics are indicated by a risk at

• **Armour Research Foundation** — Several years of effort by a group of scientists headed by N. S. Karyas, regarded as a leader and pioneer in fiber optics, has developed into 10 or 12 different fiber optics projects. Five of these projects are supported. These projects range from fundamental studies such as a study of waveguide effects in fibers for WADD, through prototype development. The group draws its own fibers, some of which are as small as



Collins Technicians Follow Audio-Visual Instructions

Production audio-visual techniques using combination slide projector and tape recorder (shown) to give operators step-by-step instructions, similar to videotapes produced by Hughes Aircraft (AW) Inc. A. P. 750, has ordered costs and improved accuracy and consistency at Collins Radio Co. plant in Cedar Rapids, Iowa, where it has undergone a three-month evaluation program reports. Audio-visual work for future and instructions for preparing tapes and slides are provided by Applied Communications Services, Cedar City, Mo. Collins also is evaluating a slide model as which normally instructions appear superimposed on photo of the slide showing close-up of that stage of construction (shown).





WHAT WAS RINGER DOING AT FORT BELVOIR? At this important Army Engineer Development Laboratory, tight 24-hour guard must be maintained. Here the SWAMI Motion Detector, developed by the Singer Military Products Division, is now undergoing rigorous tests and evaluation as a security device. No larger than an attaché case, SWAMI is designed to sense a critical area with ultra-sensitive audio energy. A division of The Singer Manufacturing Company, SMPD is composed of Singer Bridgeport, Dashi Manufacturing Company and SMI-Singer.

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0.05 to 0.1 micron, and angular size 3 micron diameter fibers. It is emitting gratings capable of transmitting infrared as well as visual images.

• **Chicago Aerial Industries.** All research and development in fiber optics at Chicago Aerial Industries over the past three years has been complete, headed. Researchers are drawing data on a fibers made from special glass formulas, making fiber plates and drawing systems. The company is considering a number of applications to conventional and perhaps color TV, image transmission systems, direct photography from cathode ray tube lens and image relay system.

• **De Mont.** Company is conducting research in fiber optics and has installed special fiber optic devices as parts of its papers on large systems to government agencies.

Much of the interest in fiber optics today is spurred by the availability of fibers from companies such as American Optical and the applications advice and assistance provided by this firm.

DEFENSE FILTER CENTER SERIES

► **Security to Expand TV Production.** Measures of the use of the USSR, a civil electronics industry production capacity can be gained from last year's Russia, which now has three million television sets in use, expects that number to increase to 15 million within five years. The U.S. produced 5.4 million sets in 1970, and this figure was set to offer rather than mechanical capacity. United States has produced more than 70 million TV sets since end of the war.

► **FIA in Server Electronics Engineers.** Electronic Subsystems Area, will survey electronics manufacturers to determine the number of engineers and scientists now employed and the percentage engaged in defense programs. The survey is being undertaken at the suggestion of the Office of Secretary of Defense Research and Engineering which hopes to use results in evaluating effect of military program changes on technical manpower needs.

► **Miniaturization Aerial Composites.** Open-Manufacturing Award, sponsored by Mission Process Research, Inc., which selects outstanding miniaturization achievements of the year, now a competing manufacturers for 1970. Breakthrough given extra details can be obtained by writing to: H. D. Gilbert Box 664, Kanan, N. H.

► **Advanced Radar Concepts.** New radar employing special spectrum techniques is being developed by Magnuson Research Laboratories at its recently

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opened facilities in Torrance, Calif. Work is partly company-funded, partly sponsored by the Army Signal Corps, according to a company spokesman.

► **Pointing Satellite** — Wideband satellite tracking system which can pick up, locate and track satellite signals and determine nature of satellite activity system is being proposed to a number of government agencies including Advanced Research Projects Agency, Wright Air Development Division and the Pacific Missile Range. Estimated cost of the system developed by Astronautics, Inc., Melbourne, Fla., is about \$5 million. Astronautics was awarded a license personnel from the Atlantic Missile Range.

► **Concrete Resistor Shield for Army Program**—Painted ceramic film resistor (AW No. 7 p. 9) ranging in value from 10 ohms to 1 megohm will be supplied to the Army Radio Corp. of America Microwave program by Murtronics, Inc., Santa Monica, Calif. To make the film Murtronics first prints a complex ceramic with area of 10 in. with a special technique, one sets values of resistors and then it makes the film with a hermetic seal. One resistor, each with 1/2 watt rated power dissipation, are placed on a single Murtronics wafer.

► **Signal in the Dotted Line**—Alpine contact boards recently introduced by various manufacturers include the following:

► **Circuit Dynamics Corp.**, Central Atlantic Division, \$890,000 contract for development of high-temperature thermal converter for use in nuclear aviation power station for space vehicle, one from Wright Air Development Division.

► **Sperry Gyroscope Co.**, \$10 million contract for additional production of landing/navigation systems for the B-57 Harrier.

► **Ryan Electronics Division of Ryan Aeronautical Co.**, San Diego, order for support equipment for AN-77A doppler navigators which feature hot or cold for use at Westland Works, Weybridge.

► **Raytheon Corp.**, Detroit, Mich., \$500,000 contract for development and fabrication of an ATC radar beacon video processing system for installation at Federal Aviation Agency's National Aviation Facilities Experimental Center (NAFEC).

► **International Telegraph and Telephone Corp.**, Federal Division, \$1.5 million from Navy for company's Fast Wave and Faulty or Faulty firing mechanisms for Torpedo missile.

► **Dowse & Morgan, Inc.**, Westbury, L. I., N. Y., \$475,000 contract for

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ENGINEERING REPORT ON BENDIX COMPONENTS



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Federal Aviation Agency for new type aircraft. For doppler omrange installations which will permit 100 knots to be installed at one end of the present 50 systems, producing no improvement again. New type aircraft will be evaluated by FAA at NAFEC in Atlantic City, N. J.

- **Electronic Communications, Inc., St. Petersburg, Fla.** 52 million in additional orders for communications and data link equipment to be used on Convair T-36s and with the USAF's Airborne Line Range Radar system for extending SAGE air defense system coverage.
- **North American's Autostar division, Downers, Calif.** will design and build a stellar inertial navigation system for use aboard a Pacific Missile Range instrument from ship. System will provide accurate information on ship's position, velocity and vertical/horizontal reference for missile tracking.

- **Phoenix Electric Mfg. Co., St. Louis, Mo.** \$1.5 million contract from USAF's Robert Air Materiel Assn. for components in support of the MD-7 for control system which company produces.

NEW AVIONIC PRODUCTS

- **Microscan relay panel, Model R361-2A**, incorporates transistors at each end to convert TFL mode to non-gate to the TFL mode in a control line. Non-converting control, chaser points and ball bearings permit high speed rotation. Frequency range of

operation extends from 17 line to 1.85 lines, over 1.1 and power handling capacity is 5 megawatts peak, 35 line with average. The panel is \$2,390 each and will be delivered 60 days from receipt of order according to manufacturer, George Corp., Van Nuys, Calif.

D.C. amplifier for other temperature or pressure control applications can operate from temperature, pressure or positioner output. Amplifier is eight 4 w, measures 1 1/2 inches, and requires 25 v d.c. at 50 milliamperes. Unit has 24 sensitivity drift over 4 hr., a rise time of 100 msec., and a frequency

response from d.c. to 60 cps—20%. It can also be used as a relay driver. Manufacturer: Vapo-Air Division, Vapo Heating Corp., 6414 W. Howard St., Chicago 31, Ill.

- **Transistor amplifier, S-band, Model 81901**, consists of a three port ferrite circulator, a reflection type diode amplifier, a hydrogen pump, a variable attenuator and a directional coupler monitor. Typical performance specifications:



Testing range of 100 cps, operating gain of 17 db, bandwidth of 20 mc at 1 db points and system noise figure of 2.5—3.0 db when operating into a mixer with a noise figure of 16 db. Applications data is available from manufacturer, Microwave Corp., Vernon, Calif.

- **Modular precision oscillator, Type N12**, a 4-watt precision 32a type, is available in accurate values of 100 to 115,000 ohms, in standard tolerance of 1% with temperature coefficient of 0.035% change per degree of centigrade



between -55C and 105C. Receiver sensitivity is 511 μ in diameter by 0.515 in. long. Voltage rating is 250 v. Unit meets performance requirements of MIL-R-101008, according to manufacturer, Coors Glass Works, Corvair, N. Y.

- **Dual multiplier, Model 3735**, provides single quadrant multiplication and squaring within an accuracy of 0.05% and four quadrant multiplication to 0.05%. Unit which does not require external amplifiers or power supplies to

operate with analog computing equipment, are available in 2, 4 or 8 channel version. Drift is less than 100 mv over an 8 hr. period, none is less than 100 mv peak, and phase shift is less



than 1 deg at 100 cps. Multiplex panel measures 5 1/2 x 9 1/2 in. Delivery for multiplier and a control panel, Model 3731, can be completed in 90 days. Duncan Scientific Co., 335 Galside St., Concord, Calif.

- **Measure power supplies** employ solid state components to achieve cost precision. Supplies measure 14 in square x 2 1/2 in. in length. One series operates from 12 to 25 v d.c. input and provides outputs from 400 to 2,000 v d.c. at 20 microamps while the other series furnishes 25 or 12 v d.c. outputs



at 100 milliamperes from a 147 v.d.c. source. Regulation is 1% on load to full load and maximum voltage shift is $\pm 1%$ from zero to 55C. Prices of the units range from \$50 to \$145 with 30 day delivery. Manufacturer: South-Flower, Inc., 4218-25th St., Seattle 99, Wash.

- **Silencing insulator, Type 2N105A**, as NPN germanium 1000 ohm, bonded in a 103.5 MILIDC can is available with 40 v, maximum collector to base voltage for relatively high voltage circuits and 10 microamps maximum reverse leakage current at 40 v. Maximum power dissipation is 200 mw at 25C. Its operation up to 95, impedance will at 52.4 ohm and between 100 and 999 at 51.6.

Schottky Electric Products, 730 Third Ave., N. Y. 17, N. Y.

ENGINEERING REPORT ON OTHER BENDIX EQUIPMENT

CAM COMPENSATOR



The type CP-26-A1 is a simple, entirely mechanical means of compensating for input data shift in relation to mixer servo loop errors, causing errors, or known environmental factors affecting the system. Compensation need for signals for manually altered or increased line action. Ask for full details.

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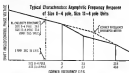
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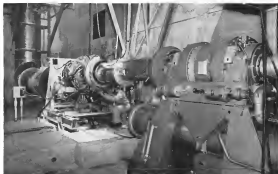


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AERONAUTICAL ENGINEERING



AIROWORK CORP. uses the Claxton dynamometer for Rolls-Royce Dart turbo-prop engine overhaul calibration at Milford, N. J.

Monitoring Increases Dart Overhaul Life

High overhaul life and turbine engine reliability can be achieved without part-time component changes but only through constant monitoring of development and operating failures and prompt remedial action, according to a statement made by a Rolls-Royce turbo-prop engine expert.

In a discussion of the service life of

the Rolls-Royce Dart turbo-prop engine, Bernard Long, chief service engineer for turbo-prop engines at Toronto, Can. pointed out that since 1953 the Dart's overhaul life has risen from 400 hr. to 3,000 hr., which was achieved last August. Despite unscheduled removal rate has been about one engine every 5,920 hr.

Long stated that at this stage "he for the majority of engine failures experienced are not of the inflight variety, but can be detected during ground checks retroactively in advance of the ultimate failure state." He cited the propeller feathering time of one over 10,000 engine hours in 1970, when service before time was at its



TURBINE shaft and inspection are followed on Claxton unit at left, capable of displacement accuracy to .0002 in. At right, Airwork employs wax a broomlike membrane to inspect Dart disk and blades for cracks and flaws. Unit has a room lens for high accuracy.

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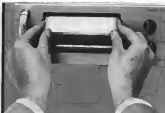


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PRATT & WHITNEY jet boost is being used at Avnet's to test a new line of engines to 3000 in.

highest. On average, he told the Avnet Corp. vice president at Melville, N. J., was due to maintenance and only one every 25,000 hr was due to an engine or accessory defect.

During Dart development, Rolls-Royce encountered these problems.

• Number of compressor casings and bracket bearing failures during the end of 1955 and early 1956. Machinists had to change the casings and brackets from aluminum to steel. Bearing failures were due to excessive wear on retaining keys during disassembly with arm or negative torque. Instructions were issued to maintain positive torque during disassembly.

• Failure of turbine blades occurred in mid-1957 on the Dart 186 and 159 after introduction of increased thrust power. Initial fix was a change in operating procedures and removal from operation of certain batches of material found to be fatigued. In the higher rate, Milestone turbine blade material was changed from Nimonic 80A to Nimonic 90. Right track, however, showed that while Nimonic 90 was an improvement, it was insufficient for the envisioned blade life. Eventually, Nimonic 105 was developed to have a high creep resistance. Creep power also was reduced and the turbine case became negligible.

Lang noted that blade failures were a major problem once in every factor exert a powerful influence. But he pointed out that, in general, agencies who have followed the recommended climb and creep power throughout the flight regime have not been plagued by blade failures.

Among other engine problems was the failure of air pumps, which Lang



This precision 30-foot antenna has a more accurate surface than any other production parabolic reflector of comparable size.



Antenna System's new solid surface, high precision 30-foot x 30-foot x 100 ft is designed to set a new standard for accuracy in the fields of radar, electronic warfare, navigation, surface propagation, tracking radar, and experimental test installations. It features:

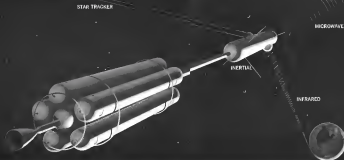
- High precision — The static surface tolerance of the first unit has been measured. The deviation from the ideal curve was around 0.002 inches RMS.
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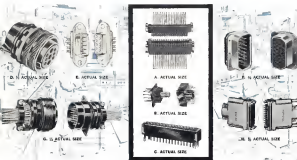
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- E Mini Edge 17 force and weighing miniature task and general. 9 to 50 Pokes Home contacts.
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- G H86-0-26508 Sophisticated aircraft and missile connectors. Performance unaffected by 3000 hours at 200°C. 3 shell styles. 6 to 88 Pokes Home contacts. H 88 60 pins 25, 43 and 60 Pokes Home contacts. Rack & panel connectors originally developed for mobile applications.

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Representative _____	
City _____ State _____	

described as important in view of the fact Pokes Home was due to vibration caused by combustion engine conditions resulting from blade failure or faulty construction. Manufacturers use a strengthened design, some a keener on production margin.

During track fatigue tests were confined to bearings, which had been salvaged by shimming, plating the outside diameter to restore the bearing fit so the bearing, otherwise not found to have a detrimental effect on bearing strength in the engine was discontinued and repeat bearings received from service. In the case (1971) of fatigue failure of high speed gears and starting, not prime bearing tools, the fit was to match an increased capacity bearing.

As overhaul life was in mid-1965, Pratt & Whitney found that rubber sealing rings in the lubrication system were proving inadequate for top efficiency resulting in high oil consumption. These were changed to a silicone rim rubber sealing ring, installed in several of the compressor and turbine sections.

Fuel Contamination

In the compressor area, engine found that shrapnel pins in fuel pump were causing erosion over and around that the major contaminant cause was fuel contamination plus use of JP-4 with lubricating qualities lower than JP-1. Fuel material was changed from phosphorous to boron-free, except a boron-free, also.

North effect of the natural spring Long continued, caused isolated cases of reduction gas induced cracking of the front bearing journal. Manufacturers set to change the geometry of the bearing journal. However, he explained, this resulted in reduced bearing area

between the splines and retainer shaft and, since the dove for major wear series is taken off the shaft, a new wear problem was encountered. Both Pratt and Whitney removed these shafts and replacing them with heads having larger internal splines to restore the wear area to the satisfactory original.

Flame tube defects of the front cooling ring downstream of the burner were due in part to disturbance of gas flow in buildup of carbon deposits and slight cracking and buckling of the tube wall. Inspectors were being instructed to include:

- Fuel-treated burners to prevent carbon buildup.
- Thickening of the inner flame ring to reduce erosion.
- Reaming method of increasing cold ring of the front cooling ring to the flame wall tube wall, to reduce effects of differential expansion and consequent cracking and buckling.
- Strengthening the front cooling ring to make certain for the retroaction of the burner.

However, these defects within the cooling ring and other, Long said, are the origin for breakdown.

Inspection of turbine disk, an engine on the J57 500 series, Long said, showed that cracking was extensive and had a slow rate of propagation. In bleeding out cracks and removing the disk in the fit two years, the problem was partly solved. As a long term fix, he noted, the disk fit two costs are undergoing a "small redesign" to reduce the local stress.

Guides in the first stage rotor hub which changed up during development cycle were, now caused by fatigue and were a function of cyclic bending stresses and that depend on the number

of starts. Initial stresses were to Minimize the component. Later a rotor was developed with an increased hub spline which reduced local stress.

Long explained that these involved lives of the order of 3,000 hr, at one year's service operation, are now being achieved, it takes in least that year to prove out a new component. He added:

"This situation is particularly true of turbine blade life since it has been learned from the past that even with the latest methods at our disposal it is almost impossible to predict an increased life and that it needs service experience to establish lives."

Microfilm Catalog Files Product Data

New system, a microfilm catalog designated VSMF has been installed at General Dynamics Corp. to reduce the amount of time spent by engineers in searching for product information and specifications data now estimated to take 15% of the working day.

More than 50,000 pages of product information from approximately 1,500 suppliers are recorded on 27 rolls of microfilm.

Engineers now must refer to a product index which refers to the engineer and as which the information is contained. This, not in this placed in a special "reader" and in a series of seconds, the film appears on a 15 x 15 in screen. A photocopy device on top of the reader will make a black and white copy of the image on the screen for further study.

Information is updated and the entire system refreshed at least every four months.



FAA Completing JetStar Engineering Evaluation

Federal Aviation Agency (see sidebar) is completing engineering evaluation of the Lockheed JetStar four-engine transport (AW No. 44-115). Now one is rolled forward on the production model and engine overhaul has been started for final tests. Airframe gas is now cost includes VFR trimmings from VOR controls, an ILS system and a weather radar. (see sidebar)



TAC is prepared to stop little wars before they get big

When trouble starts brewing, the Tactical Air Command can clamp the lid on localized aggression before it boils over and spreads to the rest of the world. TAC helps keep the peace in two main ways: (1) with its now famed CASF force which deploys quickly to any world trouble spot to work with local governments and provide air cover and attack strength as might be needed; (2) by establishing and maintaining a strong tactical airlift for Army strike forces, supplies, and support equipment.

The Lockheed/Georgia C-130 Hercules has served with TAC for more than 3 years — and has proved it meets all requirements for true airlift operation: straight-in and loading, truck bed height cargo floor, air conditioned pressurized cargo compartment, and ability to lift, land, or airdrop heavy, bulky pieces of freight. And the C-130 can get closer to the action — operating to and from strips much too rough and short for most cargo airplanes. Lockheed Georgia Division, Marietta, Georgia.



LOCKHEED GEORGIA

WORLD HEADQUARTERS FOR AIRLIFTERS AND CARGOLOADERS



RESILIENCE to the land's Piper Tri-Pacer can be seen in this side view of the two-place Colt, which was atop Piper's competition.

Airline Week Pilot Report:

Piper Aims Colt at Sports, Club Pilots

By Herbert J. Coleman

Grand Bahamas Island—Piper Aircraft Corp. has aimed its new high-wing, two-place Colt at a high degree of pilot aviation utility, and a low cost to the owner, student and rental operator.

The Colt (AW Nov. 14, p. 138) resembles the Tri-Pacer, and Piper executives say that many of the Piper components will be used in Colt production. The two prototypes were not hand-built but were done like the Lockheed Vega, production line like any other airplane.

Resemblance to the Tri-Pacer (which has been discontinued) is, however, mostly confined to general configuration. The plane is lighter and more responsive to control pressures and its

two-seat layout retains the place in the sport category for which it is intended. The plane is collected from components but the flight response is made, it was learned in a flight here. Rate of climb is excellent and the Colt's flight characteristics leave the pilot to the low end of construction—metal, but not winged type of flying.

Piper had been losing sales, with its Tri-Pacer sales and has moved into the low plane, low-wing Cherokee class to rebuild it. The Colt is aimed at the market fast developed by the Colt-Walker I. Piper company president, has high hopes that the Colt will improve that field. He notes:

"Attention has been drawn for a low-cost airplane which can be used for sport and aviation flying. For the sales area who has a large turnover, to cover, for the flying clubs which are opening up on large numbers and for the flying service operators."

Manufacturer of the Colt path Piper is a competitive position with the two-place, high-wing, standard Cessna 170 which costs \$7,495 in the standard version (AW Oct. 31, p. 31) with a 100-hp. Continental O-280-A powerplant.

The price is pegged at \$4,995 for the Colt Custom, which can be bought for \$695 down and \$29,495 a week. The Colt Super Custom is more heavily streamlined and will cost \$5,995. Both have dual controls.

Flight Check

Flight was made at a hangar in part owned by the Grand Bahamas Club, on a 747-day with gust winds at 20-25 mph from the northwest. After a complete check, the plane's 100-hp. Continental O-280-B four-cylinder dual-engine engine, having a Scarsdale propeller was started without problem.

Taxiing is simple, the nose wheel is connected to the main gear and has wheels in a single line. Visibility is good, but, the master wing is not back over head about 7 in. to give good upper visibility and side windows are large.

After a complete and power check, full throttle was applied and the plane was off the ground at 55 mph after a ground run at a low, forward angle. Best climb is at 60 mph, and the Colt was reached about here, which was about 3,800 ft. on this particular morning.

At 7,350 rpm, the Colt indicated about 95 mph at 2,500 rpm, a constant speed at 115 mph. In both power settings, cockpit instruments in low and overcast can be carried on our side.

Like the Tri-Pacer, the Colt is difficult to stall. Slow flight is at 55 mph, stall about 3,600 rpm, and covering the nose at about a 20-deg. angle. Colt stalls reluctantly with a shudder and



AERIAL view of the Grand Bahamas Club airport on the west end of Grand Bahamas Island, shows large number of Piper airplanes flown here for annual distribution meeting.

Piper Colt 108 Specifications

Type	Continental O-280-CIB
Max power	100 to 2,000 rpm
Cost	\$4,995
Length	9' 0" ft.
Wing span	35' 0" ft.
Height	6' 15" ft.
Empty weight (Super Custom)	985 lb.
Useful load (Standard)	715 lb.
Useful load (Super Custom)	665 lb.
Wing area	147 sq. ft.
Wing area	20 sq. ft.
Wing area	615 sq. ft.
Propeller diameter (Continental)	74 in.
Tower loading	15.5 lb.
Wing loading	11.5 lb.
Engine capacity	100 lb.
Fuel capacity (Standard)	15 gal.
Fuel capacity (Optional)	35 gal.

Performance*	
Top speed	218 mph.
Cruising speed (75% power, sea level)	185 mph.
Optimum cruising speed (75% power, 7,000 ft.)	115 ft.
Stalling speed	54 mph.
Takeoff run	550 ft.
Takeoff speed 50 ft. barrier	1,000 ft.
Landing speed	50 ft.
Landing distance, level 50 ft. barrier	1,250 ft.
Best rate of climb speed	75 ft.
Rate of climb	510 ft.
Best angle of climb speed	80 mph.
Service ceiling	11,000 ft.
Absolute ceiling	14,000 ft.
Max consumption (75% power, level)	6 gph.
Cruising range (Standard fuel, 75% power, sea level)	3 hr., 324 mi.
Cruising range (opt. fuel, 75% power)	5 hr., 544 mi.
Cruising range (opt. fuel, 75% power, 7,000 ft.)	5 hr., 590 mi.

* Performance noted at full power (1,800 ft.) which consists of a Super Custom Model, 2 persons, 16 gal. of fuel, 75 ft. in. at 1,800 ft. power normally at 1,800 ft. power, all performance data would be better.



COLT lightplane is parked at Grand Bahamas Club airport. In background is Bahamas Airways Douglas DC-8. Marley Airlines also operates into the single engine airport.

Custom Colt 108 Business Flying Costs

Per-Engine Expenses

Expense:	10% per year with a 20% residual at end of five years	20% per year	30% per year	40% per year	50% per year	60% per year	70% per year	80% per year	90% per year	100% per year
Annual basic fees	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100
Other fees	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100	\$100
Direct hourly operating cost	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10
Indirect hourly cost	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10
Total hourly operating cost	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20
Operating expense with 11.5 mph (Block/Block)	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10

Per-Engine Expenses

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Indirect hourly cost	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10
Total hourly operating cost	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20	\$2.20
Operating expense with 11.5 mph (Block/Block)	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10	\$1.10

slight fall through at the nose. Power off pull occurred at a bit under 50 mph, with a similar reaction and there was no tendency to fall off as a wing. During flight customers, one most watch a tendency to overcontrol in a steep turn, the tendency to use too much back pressure on the control wheel as an initial reaction.

This aircraft was equipped with the standard 18-gal fuel tank in the left wing, although standard 18-gal tank is optional, giving the Colt a 6 hr range. The engine has a mixture control.

Trim Unaffected

Generating fuel on the left wing has no appreciable effect on trim, either on the ground or when fuel has burned down.

For landing, the Colt was slowed to about 85 mph in the downwind leg and final was made at about 70 mph, probably faster than necessary but needed on this landing due to a gusty environment. Plane was held in a crab

until just before touchdown, landed straight and landed. Landing roll was short and a stopping idling was made for another landing before returning to the strip.

Instrumentation included a tachometer, speed indicator, needle-and-ball altimeter, oil pressure and temperature gauges, a fuel gauge and fuel pump. Fuel gauge is located at center cockpit, just above the panel. Radio gear was a Narco-VH-1 Superhomer. The Colt also has a direct booster panel for generator, fuel lights, ignition and radio.

Optional gyno on the lower fuselage includes the carburetor heat, ignition (interior is on the left), electric, master control and master fire. Interiors have no angles from the fuselage top at the rear of the front windshield.



L. B. Smith Designs Gulfstream Interior

Gulfstream Gulfstream turboprop aircraft owned by National Express Corp., Bedford, N. H., has 30-passenger configuration designed by L. B. Smith Aircraft Interiors. American View shows shows off seating, chairs are Fiberglas and metal to reduce weight.

for strengthening, but these have little adverse effect on stability.

Baggage can be carried in a storage area behind the seats, provided for 100 lb., but, at one distributor put it, "I'll bet the pre-rigged jump seats show up fast."

Super Custom

The high-speed Super Custom Colt instrumentation includes an engine pressure, vacuum pump, manifold pressure, directional gyro, clock, manifold pressure gauge, air temperature gauge, rate of climb and turn and bank indicator. Also included is Piper's new instrument for frequency locator, the Sharp Superlocator for VHF communications and audio navigation.

Wheel pants can be purchased for \$112 and the extra 18-gal fuel tank costs \$230. Seats, controls and landing gear are sold for \$300.

Thomas F. Piper, vice president operations, said that Colt development started with the Tri-Pacer by putting the rear seat and skids, constructing the top fuselage frame to give around headroom, clamping flaps and retaining the instrument panel.

In reducing the empty weight and mounting the Colt to a two-place airplane, Piper didn't count on the location of the 125-125 engine, which has now been put back into production. The plane has a high degree of Tri-Pacer part interchangeability. Piper noted, most birds are the same landing gear, main engine, windshield, door, tail fin, struts, seats and instrument panel.

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ever before, meets requirements of new specification MIL-T-29538. Hermetically sealed

indicators, available in 1½" and 2", require less than 0.6 watts for operation. A 2" model is integrally lighted for utmost readability in compliance with MIL-L-25467A (ASG).

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For the full story on aviation's most reliable pressure indicating system, write for publication 3049.



Standard hermetically sealed indicator, available in 1½" and 2". Model 318, a 2" indicator, is integrally lighted in daylight, orange and powder blue white and at night red. When power is off, pointer will move off-scale below zero.

Thomas A. Edison Industries

INSTRUMENT DIVISION

LAURENCE AVENUE, WEST ORANGE, N. J.



Custom Colt 108 Costs

Hourly Direct Costs

Gro & Oil	\$3.95
6 gal per hour at \$3.95 and oil including \$0.10 oil change	
Insurance & Maintenance	.36
Includes 100 hr inspection, parts and normal maintenance	
Reserve for engine & propeller overhaul	.91
Engine overhaul based on hours	

Direct hourly operating costs — \$3.60

Annual Indirect Costs

Hangar rent at \$50 per month — \$360.00

Insurance:

Full, all risk ground

& flight \$250 deductible

\$150 Rate

Sample first liability — \$250,000.00

Total annual indirect costs — \$467.64



NEW PANEL. Full instrumentation right in front of the pilot, neatly grouped according to function, permits complete 100 percent pilot alert, plenty of room for extra instruments, also map equipment.

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With approved grossing 100 pounds to 2000 pounds, the 250 hp Comanche now has 90-gallon fuel capacity as standard in the Super Customs and Auto-Pilot models—good for over 1600 miles at economy cruise. There's long range, too, with amazing economy in the 180 hp Comanche—over 1100 miles with 80-gallon capacity.

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CRISMA Skyhawk, the last version of the Model 172, has shortened landing gear and raised engine for propeller clearance.

Cessna Tailors Line for Wider Market

By Ervin J. Belton

Wichita, Kan.—Twelve models ranging from the two-place 150 up through the light-twin 310F and a four-seat rotary wing model, comprise Cessna Aircraft Co.'s 1961 line of business airplanes.

Wide line characterizes the company's intention to expand exploitation of what it believes to be a vast untapped market potential by shading all sizes and demonstrating where new installations can be achieved. Learning its lesson that a new model induced toward a particular customer may be required.

New Models

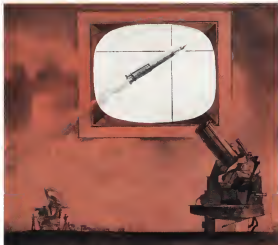
Success of this philosophy thus far is indicated by looking over the record of recent years in new models have been added. The Model 150, for example, introduced two years ago because the company's studies indicated that there was a chance for an equivalent in the compact car for training, then distance business trips, a second airplane and utility work, already has gone over the 1,000 mark in unit sales. The Model 175 and companion Skylark, introduced in 1958 to fill the gap between the light 172 and "heavy" single-engine 182, have scored approximately 2,000 unit sales. The light 172, meanwhile, brought on the market in 1955, has sold over 4,500 units and introduction of the high performance Model 210 single-engine airplane provided some 575 unit sales since its introduction last year.

Three additional models have been added to the line for 1961: four-place (AW No. 14, p. 32) show that com-



MODEL 150 two-seater (above) has landing gear retracted to improve ground handling. Model 210 (below) has extra window on each side of rear cabin, cabin roof was moved.





Pursuit by a TV private eye...

The eye on the inside that streaks across the sky is the television camera . . . part of the Norden TV theodolite, developed in cooperation with ARDC's Air Proving Ground Center, Eglin Air Force Base. This automatic eye follows the target even with poor contrast between the target and its background of sky.

Once the tracking operator is on target optically his TV camera is also on the target, which it displays on a small monitor. The picture simultaneously appears on a large TV console monitor. The console

operator sets cursor lines on this screen and the TV theodolite locks on target. From this point, target tracking and data transmission are automatic.

By equipping this tracking equipment with a TV eye and TV screens that mirror the eye's image, by applying engineering skills and experience to development of the TV theodolite, Norden continues to extend man's capabilities.

Stimulating positions are available at all levels of responsibility for qualified engineers and scientists.

NORDEN DIVISION
UNITED AIRCRAFT CORPORATION

STAMFORD, CONNECTICUT

found buildup is in demand. Model lineup for 1964 covers these airplanes:

• **Model 150**, two-place compact, which Piper this year is challenging with its two-seater Colt, shows effects of serious styling. All four models of this engine feature a revised instrument panel layout with light and navigation equipment grouped directly in front of the pilot and standard power-plant instrumentation and fuel gauges on the right. Panel can be divided with thumb-controlled red light for night operation. A magnetic fuel level indicator has been installed to give faster response to fuel level changes.

Cabin heater controls, electrical and master switches are on the top edge of the panel and emergency switches are in a vertical row at the right of the two centrifuge radio positions.

Airplane's center of gravity has been shifted forward by relocating the main landing gear two inches aft to improve landing ease and ground handling characteristics. Aerobic plastic molded control wheel, lighter and sturdier than the former magnesium wheel, is fitted. Translucent steel has been increased since 1959 by increasing size of rear windows. Added is optional equipment: an adjustable seat providing 14 combinations of tilt and length adjustment. Airplane cabin door locks have been modified to provide flush inside door handles and semi-flush instruments-to-eye mirror lenses.

Factory Prices

Blazer's factory prices for the 150 are \$7,495 for the standard version, \$8,460 for the trimmer and \$8,995 for the economy commuter. Panther-type wings, providing 10 gal fuel capacity, compared with the standard 50-gal, cost \$115 additional on a factory-assembled change basis. Panther doors, with extra transparent area in the lower portion, cost \$505 extra and a seating choice is currently available for 522 cubic inches.

• **Model 172** this year has a new forward fuselage section as a result of changing the propeller line to provide ground clearance around door hinges, the landing gear some three inches to improve ground handling. An out side baggage door has been added for easy access to the 120-lb baggage compartment and engine starting is made more convenient by installation of an electric preheating system. The new 172 has the 145-hp Continental O-300 2D engine, similar to the "C" model except for engine modifications to provide for the electric preheating system and vacuum pump drive.

For 1961 Canada has added a de-ice counterpart of the 172, called the Skyhawk, which carries a factory installed equipment the firm previously designated as optional for the 172. Price of

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- Flush Protection (No Sink-In/Trimming)
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- Full Grip Range
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widest grip range available—only with the Cherrylock Team—results in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2557-N, Santa Ana, Calif.

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Type 12 Equipment
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Automatic Direction
Finder
Plus Related Components
and Accessories



COMPLETE line of General's 1961 models was viewed by friends and distributors in display area in Mobile, Alabama. Below is recent display involving \$4 million worth of airplanes which left the factory at completion of the company's annual dealer meeting.

for model in \$9,795 and for the Skylark \$11,475.

• Model 175 and its companion de luxe model, the Skylark, have an end instrument panel for view, instrument reading at glances and the magnetic fuel level gages are also provided. Standard Model 175 has simplified starter activation through reworking of the starter control. The Skylark incorporates electric preheaters starting on its Continental 175 hp CD 300 D engine. The 1961 standard 175 is priced at \$11,995 and the de luxe Skylark at \$13,775.

• Model 180 with airplane in 1961 shows effects of styling with new interior available in choice of two colors, plus a special utility interior for easy, rugged operations. Instrument panel is re-worked and has a modified over-view working. Radio selector switch console is added to the upper right corner portion of the panel, with switches provided for two transmitters, two receivers, automatic direction finder and marker beacon receiver. Three-position hinged back seats are optional for the front position. Model 180 this year is priced at \$13,275.

• Model 185 is the company's new, heavy duty utility airplane, available for the first time in 1961 (AW Oct. 31, p. 51). Stowages, as it is named, much required for a 250-hp airplane having overusable greater load-carrying ability—the airplane can carry six adults and 270 lb of baggage with full fuel capacity with the Model 185's four-seat 120-hp baggage capacity. Powered by a fast response 260-hp Continental K1-470-1, the 185 is designed to take off at full gross weight and clear a 50 ft obstacle in 1,330 ft and land in 1,245 ft. Skis are available in five



control configurations—ability to perform only a pilot's action, a master antenna, with two state up front, state for pilot and cockpit plus two two-place rear seats, a standard four seat layout and a four place de luxe version.

Extra seats are available as optional equipment and permit carriage of useful load of 1,411 lb. Additional fuel capacity, increasing overall range from 385 mi. to 1,164 mi., with optional 1,000 gallon of fuel, the new Model 195 Starwagon are expected to be made in March. The airplane will sell for \$18,975 in its standard version.

A Model 210, to be shown publicly in January, this version will feature larger cabin windows and two additional rear seats, resulting in an increase of some 80% in transport area over last year's version.

An important feature of the "heaven" single-engine type is a revised fuselage as the cabin area, providing additional headroom through raising the height of the roof. Wing fillets provide cleaner entry of wing and top of cabin. Day gear door is redesigned to create more rigidity in the fuselage area toward the tail cone and enter loading. The instrument panel features the recording console positioned for all Cessna airplanes which have two or more cabins installed, arranged so that the pilot can select the transmitter he wishes to use and receive only on one receiver while all the others are in "On" position. Also on a panel is a new fuel flow indicator which shows fuel consumption in gallons per hour, replacing a gauge which had measured fuel flow in pounds per square inch, which should make comparison simpler.

Anytime one has a new elevator downspring connected through a cable system providing a down force on the elevator resulting in increased stability throughout the center of gravity, particularly compensating the tilt gain weight coefficient. Price of the standard Model 210 is \$21,490.

Model 310P five-place light twin jet aircraft is provided, rather than incorporating major design changes. Now equipped with a new powered and locking wings, the wing tanks are modified, while the propeller openings also have a new pointed shape. Two windows have been added to the rear of the cabin to increase rear visibility.

Finally, more positive Skylark no gear starting service is provided to simplify this procedure. The new engine eliminates the mechanical anomaly requiring need on previous design to provide the extended spark for starting. A second breaker in conjunction with a better-spaced vibrator in use, the vibrator providing sparks interrupted current to the points of the magnets, which in turn creates a high voltage in the secondary, producing literally a

shower of sparks at the spark plug. When the switch is released to moving position, the rotor breaker and vibrator become magnetized and the spark generated again stops control.

Model 310P also incorporates an improved magnet induction as time, pressure, removal of the filter without having to take off the engine cooling fan of the standard 310P is \$52,168. Model 182 has its main and nose gear lowered more than inches to improve ground handling. A new stretched fuselage, similar to that on the 210, is incorporated to provide a more durable construction. Engine cooling has been redesigned to incorporate Cessna fan boost for heavier engine cooling while at the same time speeding cool removal. Price for the 1961 Model 182 is \$15,490 and for its non-superior de luxe version, the Skylark, price is \$17,990. Skylark entry wing aircraft (AW Oct 17 p. 151) is being introduced basically this year because of studies indicating that a dedicated aircraft in business use of the helicopter is probably due in the next few years. One study made by Cessna indicates that there are over 12,000 qualified prospects for rotary wing aircraft in the U. S. today and that its Skylark four-seater fills some 81% of the potential requirement.

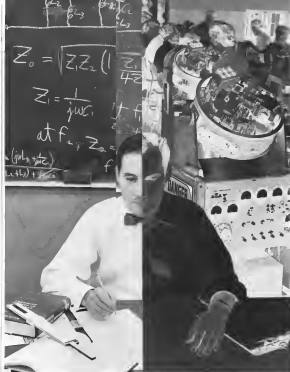
Certified both for visual and instrument flight rule operations by Federal Aviation Agency, the Skylark is being offered initially in the VFR configuration, priced at \$29,950. Plan is to provide sales and service through Cessna's large dealer network, although initially, because of its size, demonstration programs will be handled through the factory.

Cessna's record sales success sales for the fiscal year ended Sept. 30 were about \$56 million, a 20% increase over last year's record high of \$46,611,000. Total sales were more than \$193 million, second highest in company's history.

PRIVATE LINES

Shipments of business and utility aircraft by eight U. S. manufacturers in September totaled 368 units, valued at \$2,652,000 in factory billing prices. Figure brings year's deliveries to 5,655 airplanes with billing value of \$114,676,000. Total compares with 5,615 units valued at \$97,552,600 for a year in period a year ago.

Collins Radio Co. is supplying light weight navigation and communication radios for Navy Ryan Aerobee bombs under \$343,978 contract from Navy. Navy has ordered 20 Aerobee



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F-1769, F-1770, F-1771, F-1772, F-1773, F-1774, F-1775, F-1776, F-1777, F-1778, F-1779, F-1780, F-1781, F-1782, F-1783, F-1784, F-1785, F-1786, F-1787, F-1788, F-1789, F-1790, F-1791, F-1792, F-1793, F-1794, F-1795, F-1796, F-1797, F-1798, F-1799, F-1800, F-1801, F-1802, F-1803, F-1804, F-1805, F-1806, F-1807, F-1808, F-1809, F-1810, F-1811, F-1812, F-1813, F-1814, F-1815, F-1816, F-1817, F-1818, F-1819, F-1820, F-

A Toast to Environmental Testing

The Deutsch hermetic connector has withstood every kind of trial and tribulation we could think of, and will soon be tested from Cape Canaveral to Edwards as the only connector giving true hermetic sealing against extreme environmental conditions. The secret of this leak-proof performance is the unique compensation glass insert molded into the connector shell as one solid piece with contents fused right in. And, the seal guarantees sealed reliability because Deutsch handles every step of production under quality control procedures that have set new standards in the industry. For more information on the connector with the full glass insert contact your Deutschman today or write for Data File #11.

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Electronic Components Division - Manager, Export - Torrance, California



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PRODUCTION BRIEFING

Production contract in the amount of \$1,775,000 for 500 KDR-5 target dusters has been awarded by Navy to Northrop Corp.'s Radioactive Destructive Devices are scheduled to start this month. The KDR-5, a development of the IQ-19, has been used exclusively as a training target for surface-to-air missiles and anti-aircraft artillery.

Douglas Aircraft Co. has secured a \$149,745 sub-contract from Wright Air Development Division for Project Stream (Space Logistics Maintenance and Repair). The new contract will be one of six Stream awards made in September (AW Oct. 28 p. 74).

United States Steel's National Tube Division is producing high-pressure, low- and medium-pressure vessels for 14-in. inside diameters. Vessels will be placed in upright position 84 ft in length, ground in machining slots.

Lockheed Aircraft Service will produce instrument maintenance on Atlanta's Douglas DC-8s, and will maintain Delta River Corvus turboprop engines used in the Italian sector of Lockheed Aircraft Service's Island, N.Y., facility.

West German government placed an additional order with Sud Aviation for 75 Alouette II helicopters. New order brings total German Alouette order to 285 and Sud Aviation's Alouette building to 704.

Talley Industries, Cleveland, Conn., and Phoenix, Ariz., has secured three contracts totaling \$154,500. They are from Boeing-Stearns for production of 1000-mm aluminum turbine structures, from Boeing-Wichita for 3-52 engines, engine valves, turbine actuators and from Conquest for 5-55 engine valve gas production.

First Atlas airplane to be built at General's division in San Diego facilities has been delivered to the main plant at Keesler, Miss. The 128,800-lb. machine was formerly used for production of F-105s.

Gibbs Industries, Alhambra, N.J., has developed a new metal-ceramic barrier which it uses as a proprietary ceramic-metal interface, bonded seal, a modified metal sheet separator and improved electrical characteristics.

Bethel Manufacturing Co., Kansas City, Mo., will produce fuel transportation for the Jupiter 1800 under \$1 million Atlas contract. The 4,000-gal. aluminum tank barrel can operate at 1,200 gpm.



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Since they fed the first bird 22 years ago, Grove pressure regulators have set the pace. It is fact that original Grove designs are still the bases for every pressure regulator used in ground support systems today. Specify Grove regulators for dependable pressure control.



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Can you evaluate a novel inertial sensor thousands of times faster than the slow hand of your wrist? With the skills of an expert organ donor behind you, could you design and develop your own test methods, equipment and procedures? These would be for the evaluation of servo, gyro and accel sensors; performance and early prototype inertial systems, and would include precision voltage signal measurements. Write to Mr. S. L. Hirsch,

 LITTON SYSTEMS, INC. Electronic Equipments Division
Beverly Hills, California

Reliable... that one word sums up the record established by the Army's Jupiter and the performance of Silicone[®], the Dow Corning silicone rubber is part of that record.

Rubber ducts must not crack even though hoses heat and brittle by liquid nitrogen. Acrylic ducts must remain a rubbery seal despite high skin temperatures. Rubber parts must be "ready-to-go" even after long storage without signs of aging cracks. Chrysler Missile Division engineers specified Solstat to help keep the Jupiter ready. Solstat, flexible from -150 to 500 F and agless in storage.

Photo courtesy Chrysler Motor Corp.

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information

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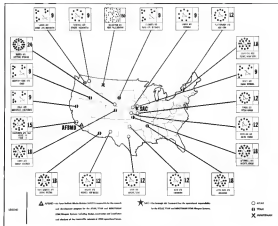
work with the military services the division also operates target ranges for the Boreas missile on the Eglin Gulf Test Range and supports the Navy's Backing Seeds missile operations and NASAs target tracking activities at Holzer Park, both on Kwajalein. The division is maintaining one of the Pacific Missile Range ships and is performing a variety of telemetry and instrumentation services.

• **Champlin Vought Research Center**—The organization is conducting basic and applied research in the fields of life sciences, electronics, energy, sources and materials.

Vought Industries, Inc.—A manufacturer of these components and 11 plants, the mobile home division acquired about 500 dealers in sales during 1974. In 1975, the division's sales increased 10% over 1974 sales, while 1976 sales are currently showing about 20% below year-earlier sales for last year. In addition to mobile homes and travel trailers, the division is planning to develop additional work for construction cost housing, portable housing, work, motel units and pre-fabricated housing. A subsidiary of Vought Industries—Comstar Furniture Corp.—was acquired six months ago to support wholesale and retail sales of the division's mobile homes and currently holds more than 35 million worth of inventory, 500% of their retail

• **Information Systems, Inc.**—An 80% owned subsidiary, ISI is engaged in design, production and installation of environmental, alarm and communications systems and more recently computerized control systems for a wide range of processing industries and for the electric power industry and other industries. A division of ISI will be moved from Chicago to Los Angeles to be integrated with Chicom. Vought's former Conquest Corp. Delberton anticipates better profits from ISI than from military business.

National Data Processing Corp.—planning in the business data-processing field, Chas. Vough acquired a 49% interest in the Dallas corporation. A contract with the U.S. Reserve Bank contract NDCP had undertaken the development of a full range of automatic check-handling equipment in 1999 and will make a major installation in the Federal Reserve Bank of San Francisco early in 1981. National Data Processing also is engaged in the development of a new generation of systems, the first of which are scheduled for installation late this year. Services include optical reading machines, credit card computers and other point-of-sale recording devices. Pointing to the high development costs incurred this year in preparing its products for the market, Vough says that he expects that 1981 appears to be the year when National Data Processing may reach



USAF's single base, zone with two or more equalizers, used various configurations. Radio-command Atlas and Titan are in 1 x 3 layouts with three launchers at each of four guidance stations. A 3-sectored Spud K200 is an empirical single in switch, supported 1 x 9 or 1 x 12 sites. Minutemen, with 150 missiles per base, will also be positioned in individual sites.

Projected fourth-quarter earnings should approximate development earnings subject to year-end adjustments. Domestic and foreign earnings from asset deliveries in 1960 will decline, covering the scheduled changeover to the new plant. The loss will be compensated for partly by estimated earnings of the Astronautics Electronics and Range Systems Divisions. Mobile home sales by Vought Industries should at least equal 1960 sales. Dryden will, and should be more profitable as a result of improvements. Operations of ISI are expected to be profitable and should show a

Sales in 1961 are expected to be about 10% lower than this year. Detachable tool, but earnings—which should total about \$6.6 million this year against \$7.46 million in 1959—are expected to continue at a high level by another report to shareholders.

Presidents of the 1st Party of Republican Australia Corp. reported consolidated net income for the first nine months of 1960 of \$1 572 385 or \$0.39 a share, compared with \$2 640 214, or \$1.79 a share for the corresponding period in 1959. Income, as based on annual stock sales of \$113 526 645, compared with \$152 952 030 for the similar 1959 period. Poole said a backlog of orders amounting to \$7.5 million was continuing to build up at the \$5.11 share price. A backlog in the government of the state Poole said (stockholders) that he expects paid a further increase during the final quarter that would bring sales and earnings for 1960 above last year.

Boeing Aircraft Corp. reported sales of \$193,249,182 for the year ended Jan. 31, compared with sales of \$181,701,958 for the year previous, and net loss of \$2,604,375, compared with earnings

of \$2,586,380 for 1978. Losses were attributed to write off of costs incurred in development and initial production of components for the Boeing 707, Convair 440 and the Douglas DC-8.

Barrett & Co., Inc., Pelham Manor, N. Y., manufacturer of electronic filters and delay lines reported earnings of \$80,678 on sales of \$1,805,810 for the six months ended Sept. 30. This compares with earnings of \$57,080 on sales of \$1,498,875 last year.

Aerovox Corp., Melville, N. J., earnings on sales of \$12,446,946 for the year ended July 31 were \$420,683, compared with earnings of \$293,479 on sales of \$9,319,141 for previous year.

Wackenhut, Inc., Melbourne, Fla., earnings for the fiscal year ended Aug. 26 were \$184,787 on sales of \$23,155,545 compared with \$188,997 on sales of \$14,007,734 for the previous year.

PROBLEMATIC RECREATIONS 41



Jack speaks the truth twice out of five times, John three times out of seven, and Ann once out of five times. Jack spent some time regarding Jill's truthfulness. Then John says that Jack has affirmed that Ann denies that Jill is a liar. Investigate this record for truth.

—Peter Dawy

The Election Tube Division of Sellen Industries wants to inform you that they have made significant breakthroughs in allowing broad band width and peak powers in L-band Klystrons.

ANOTHER TO LAST WEEK'S PROBLEM: Seven-year-olds don't have wives in Philadelphia. Fathers rarely combine their children's names. This kind of logic plus a little clapping reveals that Mr. White is the president, Mr. Brown is the professor, Mr. Black is the ambassador and Mr. Green is the janitor.

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for \$25,000 and over as selected by the Air Materiel Command:

Unclassified Contracts: **Caltech Systems** Co., San Jose, Calif., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000.

Radio Corp., Chicago, Ill., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000. **Radio Corp.**, Chicago, Ill., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000. **Radio Corp.**, Chicago, Ill., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000.

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FAA Contracts

Washington—Following is a list of unclassified contracts for \$25,000 and over as placed by National Contract Council, Federal Aviation Agency:

General Electric Products Corp., Boston, Mass., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000. **General Electric Products Corp.**, Boston, Mass., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000. **General Electric Products Corp.**, Boston, Mass., equipment and supplies contract NAJFE 33-1 on and contract AF 33-000-0000 100-000.

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a total flying time of 36,577 hr. of which 897 hr. had been in E-336. The last item 51 hr. during the 10 days preceding the accident and had had a rest period of 19 hr. and 41 min. before the last flight. Mr. Cheshire had been employed by Continental Gas Company since January 1912 and held all FAA certificates appropriate for the flight.

Captain Donald Martin, age 40, had a total flying time of 17,665 hr. of which 1716 hr. had been in E-336. He had flown 17 hr. during the 10 days preceding the accident and had not rested before the last flight was 79 hr. and 45 min. Mr. Martin had been employed by Continental Gas since July 1946, and held all FAA certificates for the flight.

ANALYSIS AND CONCLUSIONS

It is apparent that there would have been marked difficulty of no maintenance record. This may have been the leakage of a mechanical member or possibly a deterioration in handling of a part, precipitating the drop. If the wrong logic that the last inspection while the flight was in progress (reference only a few minutes earlier) it is not possible to do more than assume as to the ground of the trouble, because a considerable number of vital malfunctions could have resulted in the aircraft's turn and final plunge. The planned evidence recovered did not reveal the nature of the trouble. The nature of the aircraft's maneuvers prior to the final drop, and their proximity to the Marine Corps, any report as to what had been there at a tragic evidence of this.

It appears probable that the aircraft's speed was reduced during the thunderstorm activity, the model account for the time of the crash being a few minutes after the storm should have passed the vicinity. Being some 37 mi. to one side of the planned course may well have been an attempt to avoid the worst of the weather as indicated by the Marine Corps. There is no explanation as to why the aircraft was then from the storm too, and reported, possibly it was because of stress.

Most computers in industry by company and other reports, appear to have been of high quality. But, plain sense will explain generally, and specifically, on the particular crash account.

This and other necessary studies are currently being led the Board to initiate a series of conferences in other government agencies and with industry, to better both the economy and economy of both industries (combined) and to support their experience on the flying public. These conferences are now in the exploration stage and are aimed at the development of new procedures designed to insure that recognition of severe weather before it flows flight which could cause serious reduction of the severe weather. By the GAO.

PROBABLE CAUSE

The Board is unable to determine the probable cause of this accident. However, circumstances suggest several difficulties of an unrestrained nature during flight, though an active developing line of investigation.

WHITNEY GILLESPIE
Chairman

CHIEF GOSWAMI
Vice Chairman
G. JAMES WINTER
Member
ALAN S. BLOOM
Member
J. S. HARRISON
Member

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident very shortly after occurrence. Board investigators were immediately dispatched to the crash site. Therefore, no investigation was initiated and conducted in accordance with the provisions of Title VII of the Federal Aviation Act of 1945 in connection with the Board's management of the accident. The Board's management of the accident was in accordance with Title VII of the Federal Aviation Act of 1945, and in accordance with the provisions of Title VII of the Federal Aviation Act of 1945, and in accordance with the provisions of Title VII of the Federal Aviation Act of 1945.

Continental Gas Company, Inc. is a New York corporation with headquarters at 100 East 42nd Street, New York, N.Y. At the time of the accident it owned and operated six aircraft including N 1502 and registered 17 pilots, captains and flight engineers.

CAB Resumes Search For DC-7B Wreckage

Washington—Civil Aeronautics Board has resumed its search for wreckage of a Northwest Airlines DC-7B which crashed in the Gulf of Mexico last year.

Using new electronic underwater search devices.

Previous efforts to locate the transport have been unsuccessful, although the general location of the wreckage is known. The Board and its Bureau of Safety could not continue to search for the cause of the Northwest aircraft crash with the major anomaly of floating debris found and that it needs to recover from wreckage for examination.

The Board has signed an agreement with Marine Douglas and Son, Inc., of Houston and Marine Geophysical Associates, Inc., of Norwood, N.J. who have special equipment and knowledge of underwater search and recovery techniques. The agreement is for a \$145,000 contract to search for and recover the wreckage and is administered by Texas A&M University.

The search will be guided by a magnetic navigation system, known which is accurate within 25 ft. on 10 m search runs and within 500 ft. on 50 m runs. Also being used are a motionless depth recorder and a sonar which finds a magnetic gradiometer, which detects metal within 90 to 100 ft., will be used to locate the aircraft parts. Identification of any contents made at the bottom will be made with an underwater camera.

"one step beyond ..."

THE PRESENT TECHNOLOGY

Is preparing for the challenge of air/space in the 1980's, Convair/Fort Worth is expanding the field of sensors, guidance and control, reconnaissance systems, data processing, and electronic systems. We are looking for imaginative and creative specialists capable of evolving advanced concepts and techniques both surgically and in the laboratory.

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Technical Coverage

With advance to your selected "Four the Four Passengers" in the Oct. 3 American West, the ticket covers hotbeds you desire sounds all ten families in service who travel by air. However, there are a few bright spots showing through the clouds, such as Pacific Southwest Airlines.

PBA is not only going to meet the interests of powerful corporations, frequent and commercial scheduled flights between San Diego, Los Angeles and San Francisco will be used, if any, only as a means to American West. I want to have mentioned in our celebration of "Airline Income & Expenses," in your *Airline Observer* column. Yes, it has been an expensive and the expenditure of some others, who have access to travel up and down the West Coast, that we get better treatment and more efficient service on PBA, then we have come to expect from the other airlines.

D. K. Wagner
Pacific Biological Center

(Reagan When told Mr. Turner to do not transport story on the Nov. 30, 1979, issue p. 13....Ref.)

Re: "Arrival Causeway" letter, AWF Sept 19, p. 152

If it is unfortunate that this discussion with Mr. Deane has to be prolonged just as he has two letters he has apparently wandered off the track and attempted to create false impressions. The following are the facts of the case:

Fact #3: Although a small quantity of KV-9s has been produced, the point is that this new engine-only new becoming operational, has indicated shifter performance in the Farnold KV-2 which has been as severe since 1974. The confusion here, which Mr. Durre makes no attempt to clarify, is caused by the difference in the manner of specifying shifter speeds. The leaves given in the KV-9 specifications are Effective Speeds, whereas those given in the KV-2 specification are Total Open Times. The Effective Speeds of the Farnold shifters in the KV-2, in short double the figures in the specification.

[illegible]

Adelstein's *Week* welcomes the opinions of its readers on the issues raised in its contributor's editorial columns. Address letters to the Editor, *Adelstein's Week*, 130 E. 42nd St., New York 16, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Further, the ^{13}C NMR image is not a high-contrast photograph.¹² Mr. Dunn's illustration is selected to favor the advantages of TME. Actually, the ^{13}C in K₂C is used at a dispersion angle of 11° not 30° , as the RF

One can, however, also consider *crater* as the 5° case with $\theta = 3^\circ$ (great arc) or depression angle of 26° that took the observer to the horizon. This interpretation of the data is more consistent with the fact that the two diameters have the same value. Here the direction of elongation is along the line of sight, and the distance from the horizon to the top of the crater is $1''$ below the horizon, i.e. 1.5 to 1 . The writer does not see that any other person of adequate photographic skill could have obtained the results shown in Plate 131, though by the $20''$ below horizon level suggested by Mr. Dixon includes very little more than the upper edge of the dam itself. However, with these modifications, the data are consistent with the $10''$ point view, well within a scatter of half a mile. Perhaps he would like a better explanation (as he did to create any hole or peninsula) as INTC is of some value but

Fact #3: Regarding Mr. Dusen's original assertion that the speed of the aircraft was slowed by the reconnaissance equipment (NW July 4, p. 132) he apparently either did not read the original article by Mr. Anderson or chose to ignore it, as it clearly states (NW June 11, p. 70) that the pilot was "identified down because of the turbulence." The crying case of the oblique KA 2 was not the leading factor. The last thing to influence speed (due to turbulence) is upon high altitude speed. Since IMC is at 50,000 ft.

Fact #4: Faster lenses are definitely a virtue in all kinds of cameras and movie cameras, certainly should have them. They are an advantage in minimizing image blur, have very low bokeh (they permit the use of higher shutter speeds). The fact is the higher lens speeds do not produce sharper pictures if the camera doesn't have the necessary shutter speeds. And the K10 doesn't list a three.

Look at a kind comment on M3 item's last paragraph. The apparently tries to put the suggestion that Furchild believes that the K&Z is the correct for all time. A paragraph suggestion such as Furchild doesn't think that way. In time the K&Z will be replaced by a better answer, a correct answer and not adhere to performance, just as the RF101 will soon inevitably be replaced on the for a better design.

A. G. Niles
Deputy Psychiatrist Director
Systems Management & Engineering Dept
Fairchild Camera & Instrument Corp.
Sunnyvale, N. Y.

This is the second time around that I have had the pleasure of wanting to write a letter expressing appreciation of a very confident student job he has just done.

The article in *Esquire* Miller appearing in the Oct. 17 issue of *Intimate Works* (p. 38), entitled "Lordhood Develops Tenuous Components," is a real tribute to Barry's trademark writing capability and has done a lot to improve our ops after reading it in print.

Over the last 15 years, I have never found it to be surpassed by the very high level of technical information contained in your magazine. One at Lockheed Martin and Space Division, Anaheim, where it is considered the top source of information of the field.

Mr. W. D. Fuller, who is the manager of the Research Department in which the work has been done, and his associate engineer, Mr. W. J. Allen, as well as Dr. J. D. Mack, director of research, put me in touching and appreciative of the excellent article. Fats Miller also expressed his appreciation. Would you please put their comments on to Mr. Barry Miller when you have the opportunity.

DAVID MASON, Manager
Research & Development Sales
Lockheed Aircraft Corp.
Manuel and Space Division
Sunnyvale, Calif.

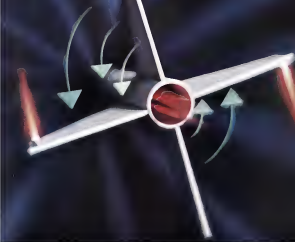
Will I not see that the Californians are trying to push us all together, step by step into isolation—and they are doing it under the guise of supporting free competition?

The *Washington Evening Star* (WV Oct. 3, p. 26) points up several points: on the White House and others to those subject to transport.¹⁴ Justice to Douglas Long Beach is order to maintain industry, competition. Being and Lockheed already have substantial military transport business and Douglas Long Beach and its 18,000 employees should also be kept busy.¹⁵

These allegations are an extremely good What use of "industrial competitiveness" is a that against the government to share up the lagging countries" is a hard back story and the showing of red figures on the balance sheet the most effective way of putting critics for soldiers, engineers—in any other environment and broad responsibility.

We can't really blame the Collaborators for the current crisis. They are merely following a pattern that has been passionately set by two others. As a taxpayer I am interested in seeing the government's purchasing dollars spent where they will buy the most, and spend where waste supplies hounds the least.

If any company can not perform the others in providing the necessary military jet transports, let's buy from that company—but on the basis of performance, not because they "should" also be best here.

Joseph H. Anderson
Charles M. ...

Massachusetts, 1990-1991, 1992-1993, 1994-1995, 1996-1997, 1998-1999, 2000-2001, 2002-2003, 2004-2005, 2006-2007, 2008-2009, 2010-2011, 2012-2013, 2014-2015, 2016-2017, 2018-2019, 2020-2021, 2022-2023, 2024-2025, 2026-2027, 2028-2029, 2030-2031, 2032-2033, 2034-2035, 2036-2037, 2038-2039, 2040-2041, 2042-2043, 2044-2045, 2046-2047, 2048-2049, 2050-2051, 2052-2053, 2054-2055, 2056-2057, 2058-2059, 2060-2061, 2062-2063, 2064-2065, 2066-2067, 2068-2069, 2070-2071, 2072-2073, 2074-2075, 2076-2077, 2078-2079, 2080-2081, 2082-2083, 2084-2085, 2086-2087, 2088-2089, 2090-2091, 2092-2093, 2094-2095, 2096-2097, 2098-2099, 2100-2101, 2102-2103, 2104-2105, 2106-2107, 2108-2109, 2110-2111, 2112-2113, 2114-2115, 2116-2117, 2118-2119, 2120-2121, 2122-2123, 2124-2125, 2126-2127, 2128-2129, 2130-2131, 2132-2133, 2134-2135, 2136-2137, 2138-2139, 2140-2141, 2142-2143, 2144-2145, 2146-2147, 2148-2149, 2150-2151, 2152-2153, 2154-2155, 2156-2157, 2158-2159, 2160-2161, 2162-2163, 2164-2165, 2166-2167, 2168-2169, 2170-2171, 2172-2173, 2174-2175, 2176-2177, 2178-2179, 2180-2181, 2182-2183, 2184-2185, 2186-2187, 2188-2189, 2190-2191, 2192-2193, 2194-2195, 2196-2197, 2198-2199, 2200-2201, 2202-2203, 2204-2205, 2206-2207, 2208-2209, 2210-2211, 2212-2213, 2214-2215, 2216-2217, 2218-2219, 2220-2221, 2222-2223, 2224-2225, 2226-2227, 2228-2229, 2230-2231, 2232-2233, 2234-2235, 2236-2237, 2238-2239, 2240-2241, 2242-2243, 2244-2245, 2246-2247, 2248-2249, 2250-2251, 2252-2253, 2254-2255, 2256-2257, 2258-2259, 2260-2261, 2262-2263, 2264-2265, 2266-2267, 2268-2269, 2270-2271, 2272-2273, 2274-2275, 2276-2277, 2278-2279, 2280-2281, 2282-2283, 2284-2285, 2286-2287, 2288-2289, 2290-2291, 2292-2293, 2294-2295, 2296-2297, 2298-2299, 2300-2301, 2302-2303, 2304-2305, 2306-2307, 2308-2309, 2310-2311, 2312-2313, 2314-2315, 2316-2317, 2318-2319, 2320-2321, 2322-2323, 2324-2325, 2326-2327, 2328-2329, 2330-2331, 2332-2333, 2334-2335, 2336-2337, 2338-2339, 2340-2341, 2342-2343, 2344-2345, 2346-2347, 2348-2349, 2350-2351, 2352-2353, 2354-2355, 2356-2357, 2358-2359, 2360-2361, 2362-2363, 2364-2365, 2366-2367, 2368-2369, 2370-2371, 2372-2373, 2374-2375, 2376-2377, 2378-2379, 2380-2381, 2382-2383, 2384-2385, 2386-2387, 2388-2389, 2390-2391, 2392-2393, 2394-2395, 2396-2397, 2398-2399, 2400-2401, 2402-2403, 2404-2405, 2406-2407, 2408-2409, 2410-2411, 2412-2413, 2414-2415, 2416-2417, 2418-2419, 2420-2421, 2422-2423, 2424-2425, 2426-2427, 2428-2429, 2430-2431, 2432-2433, 2434-2435, 2436-2437, 2438-2439, 2440-2441, 2442-2443, 2444-2445, 2446-2447, 2448-2449, 2450-2451, 2452-2453, 2454-2455, 2456-2457, 2458-2459, 2460-2461, 2462-2463, 2464-2465, 2466-2467, 2468-2469, 2470-2471, 2472-2473, 2474-2475, 2476-2477, 2478-2479, 2480-2481, 2482-2483, 2484-2485, 2486-2487, 2488-2489, 2490-2491, 2492-2493, 2494-2495, 2496-2497, 2498-2499, 2500-2501, 2502-2503, 2504-2505, 2506-2507, 2508-2509, 2510-2511, 2512-2513, 2514-2515, 2516-2517, 2518-2519, 2520-2521, 2522-2523, 2524-2525, 2526-2527, 2528-2529, 2530-2531, 2532-2533, 2534-2535, 2536-2537, 2538-2539, 2540-2541, 2542-2543, 2544-2545, 2546-2547, 2548-2549, 2550-2551, 2552-2553, 2554-2555, 2556-2557, 2558-2559, 2560-2561, 2562-2563, 2564-2565, 2566-2567, 2568-2569, 2570-2571, 2572-2573, 2574-2575, 2576-2577, 2578-2579, 2580-2581, 2582-2583, 2584-2585, 2586-2587, 2588-2589, 2590-2591, 2592-2593, 2594-2595, 2596-2597, 2598-2599, 2600-2601, 2602-2603, 2604-2605, 2606-2607, 2608-2609, 2610-2611, 2612-2613, 2614-2615, 2616-2617, 2618-2619, 2620-2621, 2622-2623, 2624-2625, 2626-2627, 2628-2629, 2630-2631, 2632-2633, 2634-2635, 2636-2637, 2638-2639, 2640-2641, 2642-2643, 2644-2645, 2646-2647, 2648-2649, 2650-2651, 2652-2653, 2654-2655, 2656-2657, 2658-2659, 2660-2661, 2662-2663, 2664-2665, 2666-2667, 2668-2669, 2670-2671, 2672-2673, 2674-2675, 2676-2677, 2678-2679, 2680-2681, 2682-2683, 2684-2685, 2686-2687, 2688-2689, 2690-2691, 2692-2693, 2694-2695, 2696-2697, 2698-2699, 2700-2701, 2702-2703, 2704-2705, 2706-2707, 2708-2709, 2710-2711, 2712-2713, 2714-2715, 2716-2717, 2718-2719, 2720-2721, 2722-2723, 2724-2725, 2726-2727, 2728-2729, 2730-2731, 2732-2733

Conventional aircraft control surfaces will not make space steps, and capsules, rockets, airbrakes, and elevators find no resistance and hence produce no reaction to their movements where there is no atmosphere. Even at altitudes only half way up, they are sluggish ineffective.

The accepted answer to a dependable steering mechanism for astronauts was a system of jet reaction controls developed and produced by Bell Aerospace Company. First used on Bell's own supersonic X-1B several years ago, the system has been greatly improved and adopted for the X-15, the Mercury man-in-space program and other space vehicles.

Through strategically located, low and high thrust (11 to

1500-pound) rocket engines. Hall's reaction controls not only position and guide the ship by controlling the roll, pitch and yaw, but they also provide for orbital changes and retro-thrust. Some of the jets are throttleable while others can be operated in combination to provide the astronaut positive and flexible control.

This revolutionary steering gear for space, available using monopropellants or high energy bipropellants, is just one of many advanced projects which are currently engaging the diversified talents of Bell Aerospace Company in the fields of rockets, avionics and space technology. Engineers and scientists seeking challenging, long-range career opportunities can find them at Bell.

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